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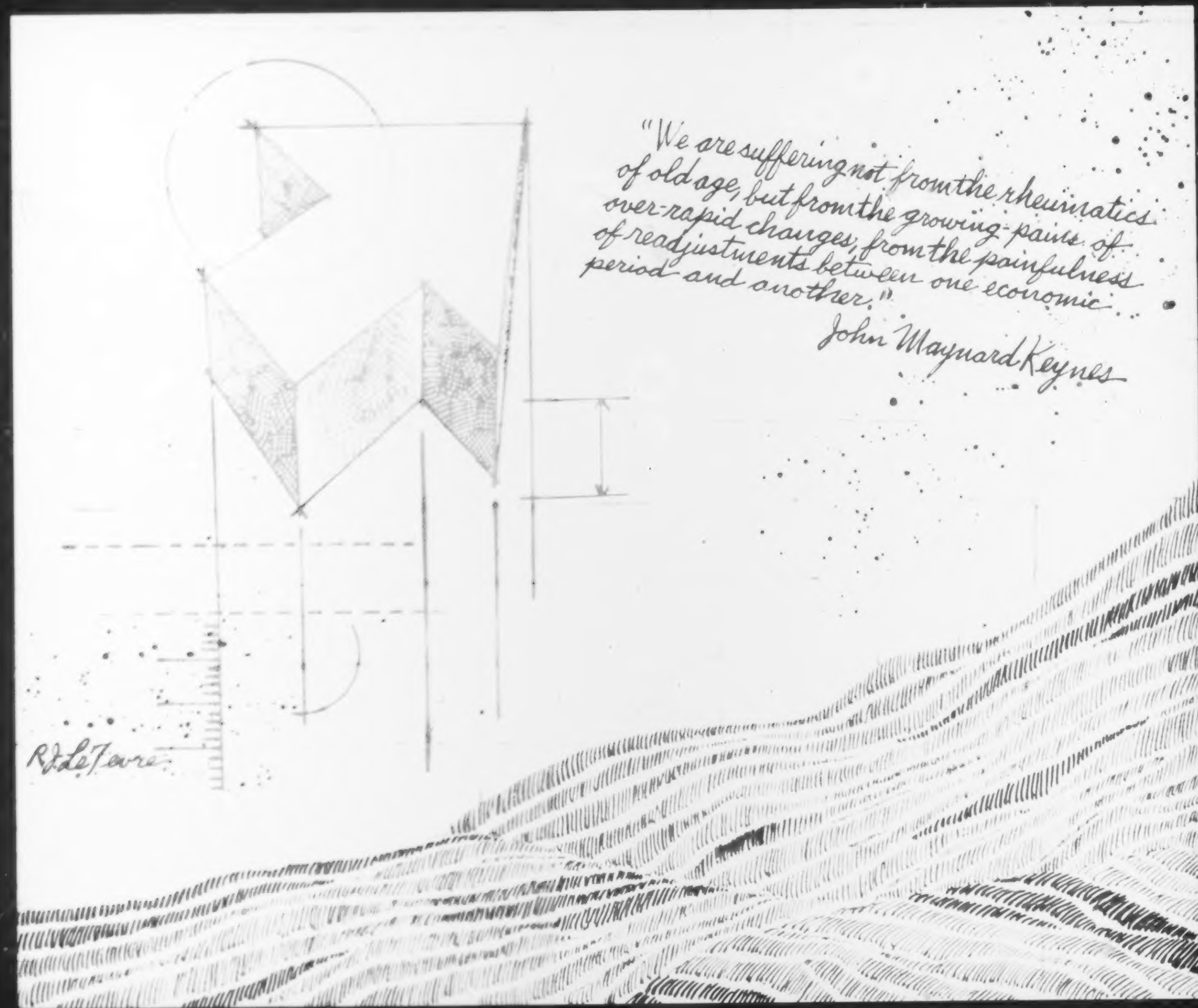
Economic Outlook 1984



"We are suffering not from the rheumatics of old age, but from the growing-pains of over-rapid changes, from the painfulness of readjustments between one economic period and another."

John Maynard Keynes

center for business and economic research / college of business administration / the university of tennessee / knoxville

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THE UNIVERSITY OF TENNESSEE, KNOXVILLE

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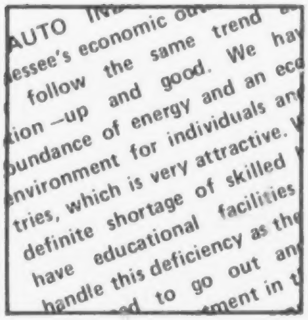

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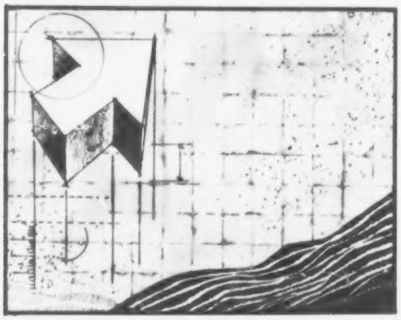

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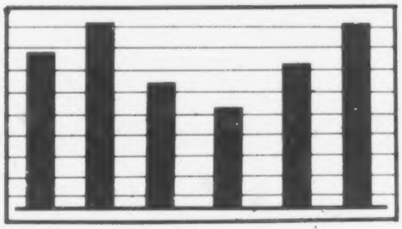

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Cover quote from John Maynard Keynes, "Economic Possibilities for Our Grandchildren," in **Essay in Persuasion**, *Vol. IX of* **The Collected Writings of John Maynard Keynes**. *London: The MacMillan Press, 1971 [1930], p. 321.*

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DIRECTOR'S COMMENTS

The year 1984 marks the 15th anniversary of the **Economic Outlook** issue of the **Survey** and the **Economic Outlook Panel** it features. The 145 Tennessee business, labor and government executives which comprise the **1984 Outlook Panel** are listed on page 5. We are grateful to each one of these businessmen and women, and also to the more than 500 executives since **Outlook 1970** who have taken the time to share their experiences as decisionmakers and business leaders.

In an inspirational guest editorial which begins on this page, Dr. James C. Cotham, III reflects on fifteen years of personal and professional change – from the time that Jim Cotham founded the **Outlook Issue**, he was my predecessor as Director of CBER (from 1969 to 1971); through Director of Executive Programs and Associate Dean of the College of Business Administration (1971-73); Vice-President for Administration of Nashville Gas Company (1973-1978); Tennessee General Manager for South Central Bell (1978-1979); Commissioner, Tennessee Department of Economic and Community Development (1979-1982); to Executive V.P., Director, and now President and CEO of First National Bank, Clarksville.

Beginning on page 6, Outlook Panel views are presented in "1984 Business and Economic Perspectives." In addition to state and national economic expectations, panelists respond to questions about national priorities, the federal debt and what should be done about it, and the linkage between state economic development, public education, and state tax revenues. Pages 20 and 21 feature an extensive sample of West, Middle and East Tennessee panelists' comments about the state of our state.

The first quarterly forecast for Tennessee to be published in the **Survey** is presented and evaluated in "Economic Outlook for Tennessee and the U.S." prepared by economists and staff at CBER using the Quarterly Tennessee Economic Model (QTEM), the state forecast extends from 1983.3 (3rd quarter, 1983) through 1985.4. Selected U.S. forecast data are provided for comparison, along with a narrative analysis of the national forecast, national assumptions, and state implications.

The concluding article, "Economic Forecasting in Tennessee," provides basic information on how economic forecasting is done at CBER. Trend and business-cycle forecasting components of The Tennessee Economic Forecasting System (TEFS) are described. An important new economic information service is announced on p. 38 for decision makers and planners in Tennessee business and industry.

David A. Hake, Director
Center for Business and Economic Research

RESPONDING TO FERMENT AND CHANGE

A GUEST EDITORIAL BY JAMES C. COTHAM, III

Over the New Year's weekend, I began reflecting on events that have happened in my life and in our state over the 15 years since I was part of the CBER team to publish the initial "Outlook Edition" of **Survey of Business**.

I left U.T. in 1973, curious to see if I could practice what I had been preaching in the classroom for 17 years, and embarked on a series of character-building work experiences. Itching to get into the faster-paced business world, I became associated with Nashville Gas Company that fall. but OPEC and the energy crisis were to change my life and personal philosophy forever. After four years of fighting supply shortages and arm wrestling regulators, I decided to enter the fast-moving technological world of telecommunications, a true growth industry. Soon I was to learn that the courts had decided to dismember the Bell System. You know the rest of that story.

Then, in 1979, a once-in-a-lifetime public service opportunity came my way. As a member of Governor Alexander's cabinet, I became part of an administrative team operating in what Charles Dickens might describe as "the best of times . . . the worst of times." We were presented many opportunities from the very outset. Our state was mired in a national recession, we faced declining tax revenues, unprecedented inflation, choking interest rates, angry citizens, and the beginning of record unemployment. Yet, without a doubt, my three years in state government were the most challenging and fulfilling period of my professional career.

Although as commissioner I was sometimes critical of the so-called state "bureaucrats," I have since developed a growing respect for the tremendous number of outstanding career-oriented professionals in state government. They have a significant impact on our future – attracting jobs, ensuring enough pure water and clean air, planning highways, providing health services, and designing technical skills and academic programs.

We do not pay state government professionals enough or provide the incentives for them to work extra hard, but most do. They are not rewarded for creative efforts and intelligent work or shown enough appreciation for a job well done. Because of this, we are losing too many good people. It is important that we figure out how to recruit and retain the best. Since government is only as good as the quality of people employed, everyone who is called upon to serve should do so.

A prime benefit of serving in government is to gain a better understanding of the entire process: how leadership works, how consensus is developed, how new ideas are accepted, and how change occurs. It was very enlightening to see firsthand how tough it is to efficiently manage scarce resources, trim budgets, cut personnel, provide an acceptable level of services, make citizens happy, and keep employees motivated and teachers satisfied, without an increase in taxes. I also became aware that while most people are for reducing the size of government, most want it accomplished at somebody else's expense.

The level of understanding about the economic framework of our state concerns me. Tennessee is filled with paradox: we have plenty of prosperity but too much poverty. We have economic growth but also economic decline. Statewide, we have an imbalance in the location and skill level of jobs. In hindsight, over the years, we have attracted too much low technology, low-growth and low wage-paying industry.

But the good news is that economic development is focusing on the future with increased community preparedness and much better state/local cooperation in jobs recruiting efforts. We are working hard to improve employment skills and to reduce adult illiteracy. Our governor is making an historic effort to increase the quality of our public schools. He is trying to strengthen our state's ability to attract and develop the jobs of the 1990's and beyond.

Outside of improving education, Tennessee's greatest challenge will be to come to grips with tax reform in an unselfish way. As long as our state depends on a consumption-oriented sales tax system, it will be very difficult to meet the needs of our citizens, young and old, in the years to come. We must be prepared to pay for the future. Currently, Tennessee's per capita tax burden is the lowest in the Southeast and the second lowest in the nation.

In meeting our challenges, we need to remember that throughout the story of man's development, there has been one common thread – change. Periodically, there are breakthroughs in science, technology, economics or politics that become catalysts for dramatic change. Monetary and political fortunes have been made or lost based on the ability to anticipate and manage change. Industries, once pillars of strength and power, have come and gone with changing technology.

Freedoms have been gained and have been surrendered due to changes in man's will to fight and survive. Civilizations have risen and fallen with improvements in economic well-being, with increases in the desire for pleasure and with changes in fundamental values and spirit.

With all the ferment about us, conditions are ripening for another giant step to be taken in the ascent of man. Not since the industrial revolution has there been such sweeping technological change. Our tools of understanding and our investments in technology are often obsolete before we can fully grasp them or put them to productive use. Revolution is taking place in communications, transportation and financial services. Worldwide changes are occurring in trade and political relationships. Consider such problems as budget deficits, national defense, and the retraining required for millions of American workers who will be displaced by the technological transformation unfolding around us.

As the National Commission on Excellence in Education states, "History is not kind to idlers." In conducting our business and personal affairs, we need to overcome the almost irresistible urge to view life through a rear-view mirror, to assume the future as an extension of the past. The chief barrier in taking advantage of opportunity is the inability to face change and to do something affirmative about it. Positive changes can always be made in such procedures as governing a state, managing a business, a community, or any public institution. For leaders and decision makers who are paralyzed by routine and continue to operate using time-worn and traditional methods rather than new and innovative ideas, the years ahead could be a disconcerting time, a time of disappointment and failure.

Looking back 15 years since my days at U.T., I am aware that many of us have been managing and working on the edge of obsolescence. Looking ahead to the next 15, I see that most will be living on the threshold of fresh opportunity. Now is the time to demonstrate courage of conviction and prepare.

One of the most valuable lessons in life is to learn that ultimately you are the one who is responsible for yourself. You do not depend on or wait for others. You do not fault others or blame circumstances. You do not depend on momentum of the past. You take charge. Draw your own conclusions about the potential impact of changing circumstances on your business, your investments, your family, and your own future. Make your own plans and set your own goals. Shape your own strategies and develop your own responses.

The fact is, our future will not be automatic. It will be what we make it. We have no guarantees, only an opportunity to rise to our own full potential. ■

Panelists For The 1984 Survey Of Business Attitudes

Norbert J. Ackermann, Jr., President, Technology for Energy Corporation, Knoxville
Richard N. Aft, Executive Director, United Way of Greater Memphis, Memphis
✱ **James H. Alexander**, Executive Director, Insurors of Tennessee, Nashville
* **Reid Ashe**, President, The Jackson Sun, Inc., Jackson
Charles E. Ashworth, General Manager, ITT Continental Baking Co., Inc., Memphis
† **Tom N. Austin**, Chairman-Board of Directors, The Austin Company, Inc., Greeneville
* **Alf T. Barnette**, Executive Director, West Tennessee Industrial Association, Jackson
Charles R. Bell, Manager-Employee Relations, Allied Corporation, Knoxville
* **Thomas R. Bell**, President, East Tennessee Natural Gas Company, Knoxville
Ernest H. Bennett, Plant Manager, E. I. du Pont de Nemours & Company, Chattanooga
Edward C. Blank, II, Attorney-at-Law, Trabue, Stardivant & DeWitt, Nashville
* **John C. Bolinger, Jr.**, Chairman/President, Tennessee Natural Resources, Inc., Nashville
Stephen J. Boyer, President, Tennessee Retail Federation, Nashville
L. P. Brittain, Jr., Vice President-Industrial Development, Kusan, Inc., Brentwood
Berry Brooks, Senior Vice President, Commerce Union Bank, Nashville
† **John D. Canale**, President, D. Canale & Company, Memphis
✱ **Richard W. Cardin**, Managing Partner, Arthur Andersen & Company, Nashville
Ralph D. Carnathan, Director of Industrial Development, Tennessee Valley Authority, Knoxville
* **William R. Carter**, Chairman, Carter Ltd., Fayetteville
Charles F. Casey, Chairman, Container General Corporation, Chattanooga
Donald E. Cash, Supt.-Employee Relations, E. I. du Pont de Nemours & Company, Memphis
* **William V. Chafin, Jr.**, Executive Director, Maury County Chamber of Commerce, Columbia
† **Roger Charest**, Plant Manager, Tupperware Company, Halls
† **Edmond D. Cicala**, President, Edmond Enterprises, Inc., Memphis
David L. Coffey, President, The Nucleus, Inc., Oak Ridge
Steve G. Conerly, President, Pet Incorporated-Dairy Division, Johnson City
* **Charles W. Cook, Jr.**, Chairman, Third National Bank, Nashville
† **Ormond C. Corry**, Research Professor Emeritus, Knoxville
* **James C. Cotham, III**, President, First National Bank, Clarksville
* **John I. Cox, Jr.**, Vice President, Tennessee Eastman Company, Kingsport
Gary W. Cunningham, Corporate Consultant, Gannett Company, Inc., Nashville
Thomas H. Davis, C.P.A., Internal Auditor, Tennessee Farmers Co-op, LaVergne
† **Charles H. Dean, Jr.**, Chairman of the Board, Tennessee Valley Authority, Knoxville
* **R. D. Dillender**, Plant Manager, 3M Company, Chattanooga
John W. Edwards, Jr., President, Riley Hardware Co., Inc., Clarksville
Arthur R. Eggert, Plant Manager, Bridgestone Tire Manufacturing, LaVergne
Paul M. Engelmann, Executive Director, United Way of Greater Chattanooga, Chattanooga
* **Joseph R. Exum**, Chairman, Leland-Powell Fasteners, Inc., Martin
Doris Ferguson, Manager-Financial Relations, Malone and Hyde, Inc., Memphis
* **John Flaugher**, First Vice President, Williamson County Bank, Franklin
Robert L. Floyd, Senior Vice President, 1st American National Bank-Eastern, Kingsport
W. K. Ford, President, Ford Construction Company, Dyersburg
† **William A. Fortune**, Chairman of the Board, Fortune, Masingill, Parish Development Corp., Knoxville
* **N. Hoke Fowler**, President, Forest Furniture Industries, Inc., Morristown
* **John F. Germ**, President, Campbell & Associates, Inc., Chattanooga
William A. Gibson, President, Elographics, Inc., Oak Ridge
* **William C. Grater**, President/General Manager, Bowater Southern Paper Company, Calhoun
† **M. E. Greiner**, Vice President, Scripps-Howard Broadcasting Company, Memphis
* **Thomas A. Griffin, Jr.**, Executive Vice President, Mid-South Title Insurance Corp., Memphis
* **Darwin R. Griva**, Vice President/General Manager, Chromalox Divsion, Emerson Electric Company, Murfreesboro
* **Joe R. Grooms**, Controller, Martin Marietta Aluminum Sales, Inc., Milan
Kyle Hale, Manager-Operations, Century Electric, Inc., Lexington
† **F. W. Hamilton**, President, Industrial Development and Warehousing Inc., Jackson
I. B. Hammer, Director of Marketing, Memphis Publishing Company, Memphis
* **Fred Harvey, Jr.**, President, Harveys, Nashville
James Haslam, II, President/Chief Executive Officer, Pilot Oil Company, Knoxville
Robert M. Hendrix, Sr., Chairman of the Board, Dyersburg Production Credit Association, Dyersburg
Roger Hibbs, President, Union Carbide Corporation-Nuclear Division, Oak Ridge
* **Waymon L. Hickman**, President, First Farmers and Merchants National Bank, Columbia
Armond Hirtriter, Vice President-Operations, Millers, Inc., Knoxville
K. D. Holder, Plant Manager, Trenton Mills, Inc., Trenton
† **J. Fred Holly**, Arbitrator, and Professor Emeritus, Knoxville
James W. Hopper, Manager-Employee Relations, ITT Telecom Corp., Milan
* **R. D. Hubbard**, Chairman of the Board, AFG Industries, Inc., Kingsport
Robert L. Huffman, Personnel Manager, Procter & Gamble Company, Jackson
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† **Donald W. Jackson**, President, Tennessee Taxpayers Association, Nashville
Pat J. Jansen, Sr. Vice President-Finance, Allen & O'Hara, Inc. Memphis
Ralph Jared, President, Cookeville Production Credit Association, Cookeville
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Glenn W. Jones, Associate Director of Research, J. C. Bradford & Company, Nashville
Paul Keckley, President, Keckley Market Research, Nashville
* **Wendell C. Kirk**, President, Heritage Federal Savings and Loan Association, Kingsport
Richard D. Klasen, Plant Manager, Ford Motor Company, Nashville Glass Plant, Nashville
* **Gene C. Koonce**, President/Chief Executive Officer, United Cities Gas Company, Nashville
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Timothy F. Lennon, Vice President/Controller, AVCO Aerostructures Division, Nashville
W. Carroll Leonard, Plant Manager, Missile Systems Div., Raytheon Company, Bristol
* **Eldon Leslie**, Executive Director, Industrial Development Board, Cookeville
* **Ronald S. Ligon**, President, Christus Gardens, Franklin
† **Herbert W. Lindahl, Jr.**, President, State Industries, Inc., Ashland City
† **Howard W. Loveless**, President, Sealy Southeast, Memphis
Mel Luigs, Jr., Controller, Plumley Companies, Paris
† **Thomas A. Lupton, Jr.**, President, Stone Fort Land Company, Chattanooga
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Wayne Murdock, Executive Director, United Way of Greater Knoxville, Knoxville
Robert Murphy, Agricultural Statistician in Charge, Tennessee Crop Reporting Service, Nashville
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Lynn Polte, Owner, Racquets and Jackets, Inc., Knoxville
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Patricia D. Postma, President, Tennessee Valley Ventures, Inc., Oak Ridge
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Robert A. Rogers, Vice President-Manufacturing, Plumley Rubber Company, Paris
Donald A. Russell, Vice President-Operations, Mead Paper Company, Kingsport
Herbert St. Goar, President/Chief Executive Officer, Dixie Saving Stores, Inc., Chattanooga
C. Wendell Short, Personnel Director/Buyer, Gary Manufacturing Company, Gallatin
George W. Shuff, Executive Director, Middle Tennessee Industrial Development Association, Nashville
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James F. Smith, Jr., Chairman/Chief Executive Officer, First American National Bank, Knoxville
M. Lee Smith, Publishers and Printers, Nashville
Andrew J. Spurgeon, Senior Vice President, Merrill, Lynch, Pierce, Fenner & Smith, Inc., Nashville
Leonard J. Stack, Vice President Operations, Emerson Electric Company, Paris
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Douglas P. Thurley, Plant Manager, TRW, Ross Gear Division, Lebanon
* **Julian P. Townsend**, President, Townsend Supply Company, Jackson
* **Earl H. Triplett**, President, Midland Bank & Trust, Memphis
* **Carl W. Truebe**, Plant Manager, ICI Americas, Inc., Chattanooga
Richard E. Tumblin, Chartered Life Underwriter & Chartered Financial Consultant, The Equitable Life Assurance Society, Knoxville
T. R. Turner, Manager of External Affairs, Buckeye Cellulose Corporation, Memphis
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Jack Whitfield, President, Sverdrup Technology, Inc., Tullahoma
Charles E. Wolfenbarger, President, International Union of Electricians, Local 748, Jefferson City
† **W. Lewis Wood, Jr.**, Senior Vice President, Allen & Hoshall, Inc., Memphis
Tom Yount, Commissioner, Tennessee Department of Employment Security, Nashville
* **Allen Zang**, President, Nashville Bridge Company, Nashville

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✱ These panelists have served every year for 15 years.
† These panelists have served 10 or more years.
* These panelists have served 5 or more years.

WHAT'S AHEAD:

1984 BUSINESS AND ECONOMIC PERSPECTIVES

David A. Hake
Donald R. Ploch

Tennessee business executives are nearly unanimous in their expectation that 1984 will be a better year than 1983. In this presidential election year, they solidly support the Reagan Administration, though they are worried about national budget deficits and are more willing than the administration to use a mix of expenditure cuts and taxes to reduce them. Most think that expenditures by the State of Tennessee are low relative to its needs. Specifically, panelists would spend additional moneys on some well-thought-out plan to improve education and would support additional taxes to provide these funds. They are concerned for education because they sense dangerously low levels of ability in basic skills and because they see education as a key link in economic development. Other issues of concern are high unemployment in the state and the effect of persistently high interest rates on the business recovery.

The 1984 Outlook Panel consists of 145 executives representing diverse industries and all geographic areas of the state.* The fifteenth annual questionnaire was tabulated in December.

Panel Views of The National Economy

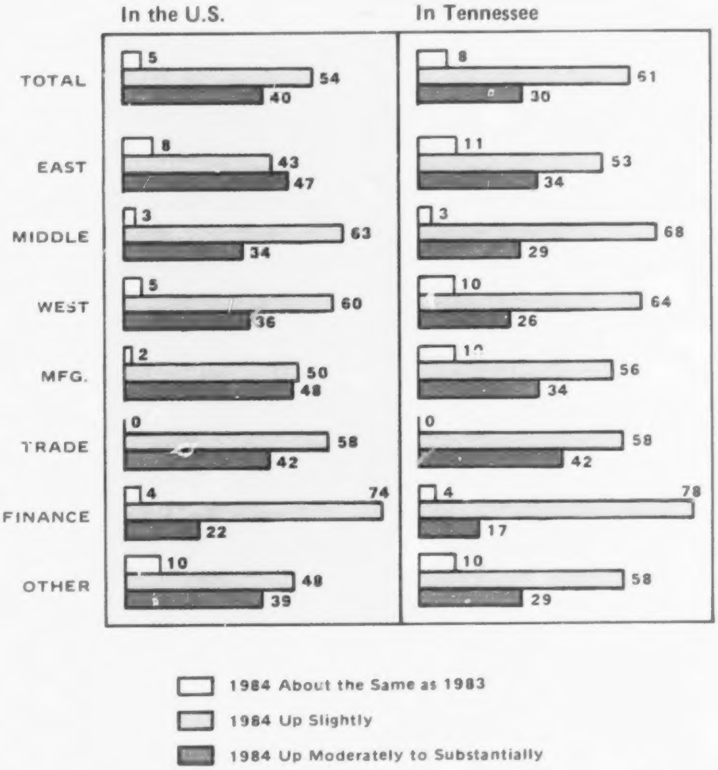
Panel views on the overall expectation for the 1984 U.S. and state economy as compared to 1983 levels are shown in Figure 1. While 5 percent of the total panel expects the U.S. economy to remain about the same, 94 percent expects the 1984 economy to be up relative to 1983 levels, with 40 percent of the total panel indicating the improvement to range from moderate to substantial. Panelists from Middle Tennessee are the most unanimous in their opinions (97 percent indicating improvement of some magnitude), but the strongest positive views are held in East Tennessee, where 47 percent of the panelists think the national economy will be up moderately or substantially. Viewed as representative of industry groups, the finance panelists are in closest agreement (74 percent indicating "up slightly"), while the manufacturing sector is the most ebullient, with 48 percent expecting moderate or substantial improvement in 1984.

The Tennessee Outlook

The overall economic outlook for Tennessee is strong, with 91 percent of the panel expecting the Tennessee economy to be up in 1984 relative to 1983. Though positive expectations are nearly unanimous for Tennessee, they are not as strongly positive as those for the U.S. In every geographic and industry sector except trade, where national and state responses are identical, there were fewer panelists in the "up moderately" category and more in the "up slightly" category.

Within Tennessee, panelists from Middle Tennessee are the most uniformly optimistic, with 97 percent in the "up" category. Those panelists in finance are the most cautious in their expectations, with 78 percent indicating "up slightly" and just 17 percent indicating "moderate" relative improvement in 1984. Despite apparent statistical agreement, the comments of panelists reflect a range of views and a bit of Tennessee independence.

1 The Overall Economic Outlook
Expectations for 1984 Compared to 1983



Note: Data shown are percentages of total panelists grouped as specified.

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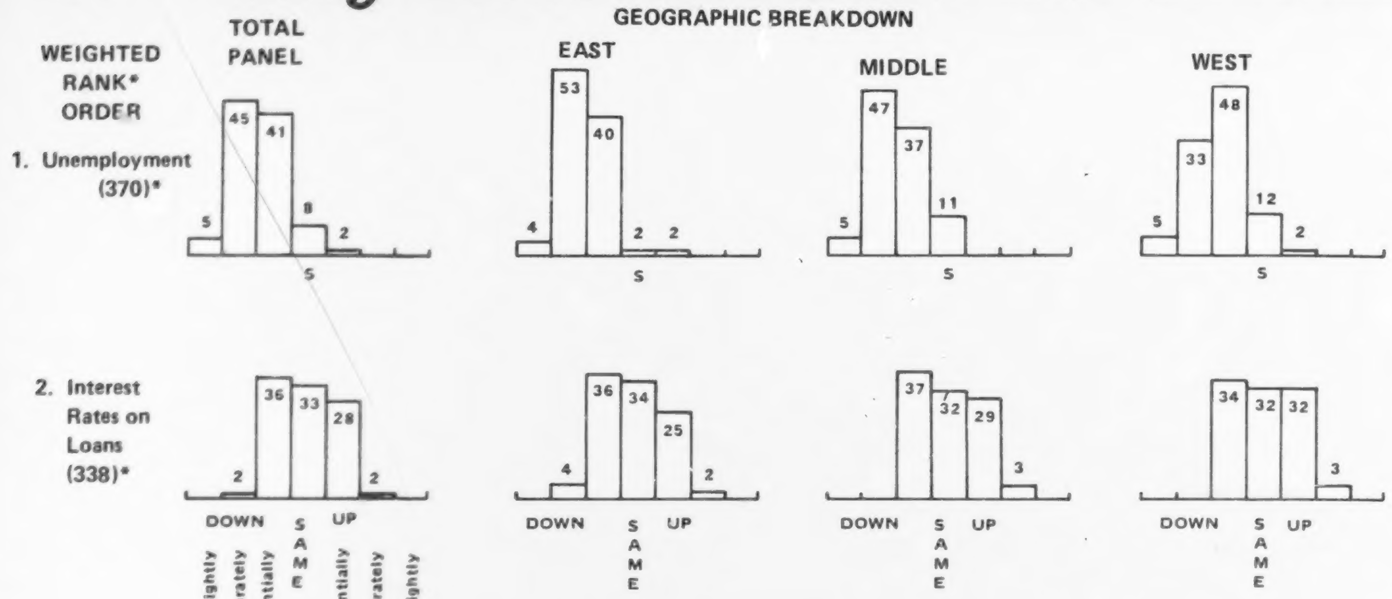
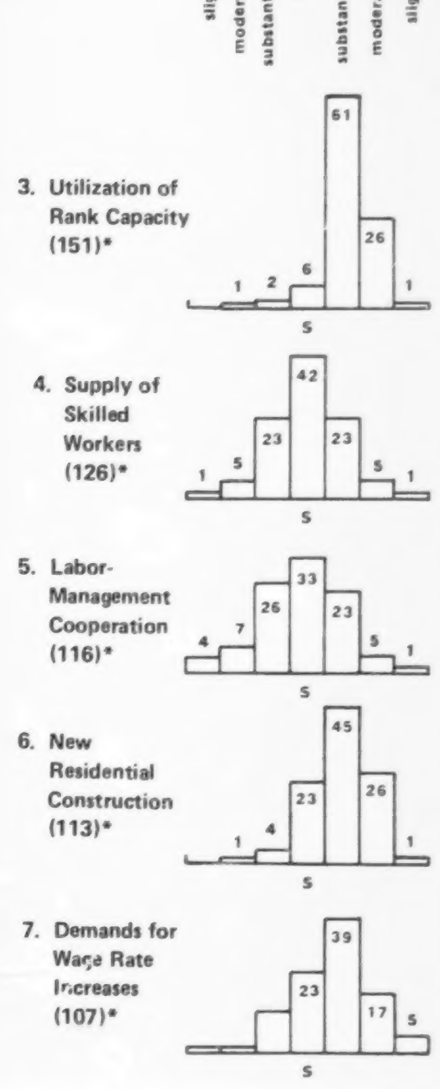
*Eleven executives' responses were received too late for inclusion in tabulations. Their comments are, however, included in the narrative samples. Statistical tabulations are based on responses of 134 executives distributed as follows: 57 East Tennessee, 38 Middle Tennessee, 39 West Tennessee. Broad industry groups are: 47 manufacturing, 17 wholesale and retail trade, 22 finance sector and 48 classed as "other" which includes leaders from labor, education, state and local government and the service sector.

2 Key Economic Issues in Tenn





An East Tennessee manufacturer comments:

> I believe the outlook for Tennessee is positive in 1984, but less positive for the U.S. as a whole. Tennessee's area of strength is in the quality of life, while its weakness is in the area of limited job opportunities. The greatest area of concern is in energy costs, but this seems to be moderating.

An executive from East Tennessee:

> Tennessee's economy should improve slightly in 1984. I feel Tennessee should capitalize more on our river network for industry. Our greatest weakness is the caliber of our educational system.

A finance executive from East Tennessee:

> I believe Tennessee's overall economic outlook for 1984 is quite bright, basically because of the state economic development program strongly supported by the governor and the business community. Also, business and labor are working together better than they have in many years. On the other hand, we must improve the level of income to our workers in all areas and must do a better job of educating our youth.

A Middle Tennessee trade executive:

> Tennessee's manufacturing sector should be approaching 80 percent of capacity in 1984. This should occur because of the need to replenish inventories. Orders were not placed until late in 1983 in order to clear inventories already in the system.
>
> I believe particular attention should be given to seeking ways to improve the short-term capital position of cash-starved businesses, without extremely high interest rates or undue red tape. Cash flow continues to be a problem to many small businesses across Tennessee.

More panel quotes are to be found at the end of this article.

Key Economic Issues for Tennessee in 1984

Outlook panelists were asked to review and evaluate 19 issues of potential economic concern in Tennessee, recording their expectations for each in 1984 relative to 1983. They were also asked to rank the issues of greatest concern to them in 1984. The ranks were weighted and summed to arrive at a panel concensus on the key economic issues. The seven issues receiving the most votes and generating the most concern in comments are shown in

essee: 1984 Compared to 1983

INDUSTRY GROUPS

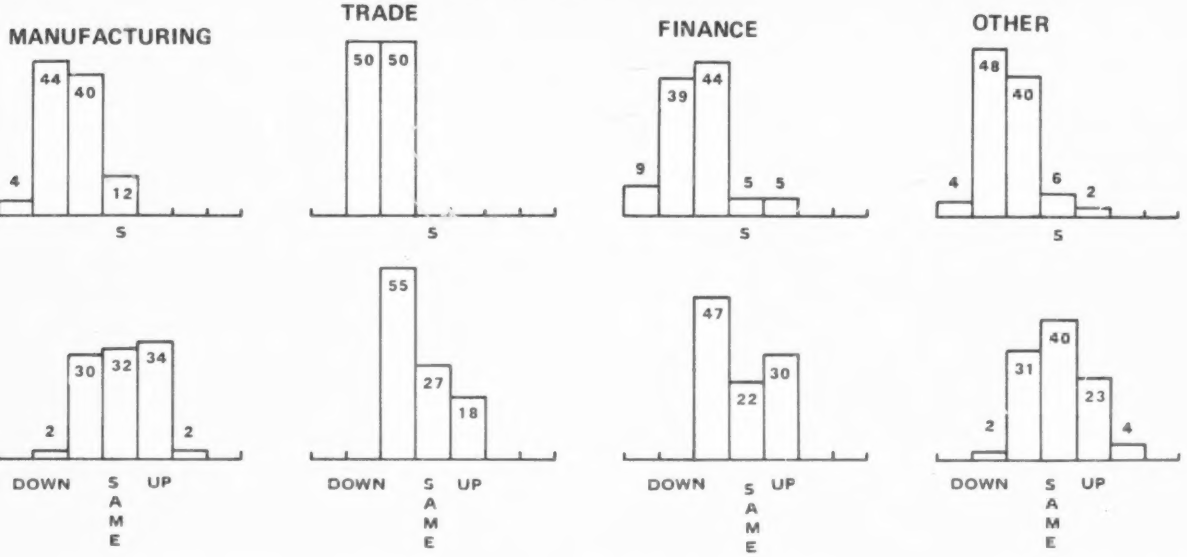


Figure 2. Unemployment and interest levels draw the most attention, each having a weighted rank sum over twice that of the issue ranked third. Geographic and industry group responses are shown for these two issues.

Issue #1 — Unemployment

While identifying unemployment as the key economic issue in Tennessee in 1984, over 90 percent of the total panel believes that the rate of unemployment will be down, with a majority of the panel indicating their expectation for moderate decline in this important economic indicator. Geographically, panelists from the eastern portion of the state expect greater improvement in the unemployment rate than those in West Tennessee. In the industry breakout, expectations for improvement are slightly greater for panelists from the manufacturing sector than from bank and savings and loan executives. A sample of panelist comments follows:

A Middle Tennessee finance panelist:

> **Tennessee suffers from both unemployment and underemployment. As we shift from a "smokestack" economy to a service and high technology economy, our educational systems will need substantial changes, particularly to retrain our work force and better train those entering the work force.**

An East Tennessee finance panelist:

> **I question that a lot of Tennessee's manufacturing capability will ever be used again. It is obsolete. We lack the skilled labor force and the required educational level for an information-based economy.**

An East Tennessee finance panelist:

> **I do not believe that the unemployment rate will fall much below the 8 percent level in 1984, which is still a very high level. To correct the situation in Tennessee, retraining, education and creating an atmosphere conducive to economic investments should get top priority.**

From three East Tennessee manufacturers:

> **Since Tennessee has a higher unemployment level than the U.S., those that are employed are somewhat defensive and cautious about their spending habits. This has an overall subduing influence on general business activity. We must work harder to bring new industry to Tennessee.**
>
> **Employment is more than income. It is self respect. It affects the public mood. The best solution to unemployment is the long-range solution: better on-the-job training and school education. We must upgrade the intelligence and capability of our labor force.**
>
> **Businesses will keep working to increase productivity, therefore not hiring at the rate one would expect. Unemployment payments will remain high.**

A West Tennessee service sector executive:

> **Unemployment, especially among young blacks, has been a major problem throughout the South and Middle and West Tennessee for several years. While there is some improvement in 1983, the problem remains chronic, particularly in rural areas of West Tennessee. The governor's Job Conference activities could and should be speeded up. This, along with expanded employment services and vocational education programs, would have an immediate impact on this problem.**

And finally, an observation from a manufacturer from West Tennessee:

> **Unemployment combines all the contributing factors — high interest rates, diminished housing starts, consumer demand, public or government revenue — into one problem. There is no direct way to**

> **attack it. The solution lies in correcting indirect causes. This makes it easy to talk about endlessly, and difficult, if not impossible, to resolve by head-on assault. Consequently, unemployment is a safe and popular political issue.**

Issue #2 — Interest Rates on Loans

Of almost equal concern to the panelists is the issue of higher interest rates. Although agreeing on the importance of the issue, there is no concensus as to the direction interest rates will take in 1984 relative to 1983. With reference to total panel responses in Figure 2, 38 percent expect interest rates to be up in 1984 relative to 1983, one-third expect rates to be about the same, and the rest (nearly one-third of the panel) think that rates in 1984 will move below average 1983 levels. Viewing the responses by geographic sector reveals the striking similarity of panelists' perceptions about interest rates. Industry group tabulation does hint at a difference in perception. Panelists in the trade and finance sectors are distinctly more pessimistic than executives in either manufacturing or the combined service and miscellaneous group.

Panel commentary is varied, touching on each point of this thorny issue, as can be seen in these three comments by trade executives from West, Middle and East Tennessee, respectively:

> **The single most important feature will be control of government expenditures at all levels. Interest rates touch almost every segment of the total economy, and deficit spending will provide upward pressure on all interest rates.**

> **High interest rates smother business profits, expansion, employment, consumer spending, housing, etc. I would favor a lid on interest rates so that small business can survive and construction industries can put people back to work.**

> **My number one choice is based on my very basic and primitive knowledge of economics. It seems that the interest rates are still high enough to cause second thoughts toward expanding. Yet, it requires business expansion to create growth and strength for the recovering economy. I have no solutions, but I do have one general recommendation. The government should stay out. Artificial controls do not work. Supply and demand must set natural levels of operation.**

Small business development and construction industry linkages in Tennessee are the concerns of service sector executives from East and Middle Tennessee:

> **The economy is much more dependent upon small businesses than is recognized by the media, politicians, and average citizens. The cost of borrowed money at double-digit rates is not feasible to most small businesses. The cost increases their overhead, or reduces profit to the point of no return on investment. The problem is even more critical when venture capital is borrowed for start-up of a new business.**

> **High interest rates will slow housing and construction of rental units, and this will slow the Tennessee economy.**

The high, real rates of interest are the concern of a Middle Tennessee finance panelist and an East Tennessee executive:

> **Interest rates in relation to the level of inflation are too high for a continuing strong recovery which will create jobs, reduce unemployment, and renew consumer confidence to spend.**

> **Interest rates are higher than they should be with present inflation rates. This inhibits expansion. Only more confidence in fiscal stability in Washington will bring these rates down to traditional levels.**

Finally, this comment by a manufacturing executive from East Tennessee seems to put a point on this issue:

> **Interest rates are the key factor in our economic equations. However, a lot of the economic factors indicated above are interrelated and are not independent. Thus, to focus on only one factor, the danger is great that we will over-simplify the solution(s) to our economic problems.**

Issue #3 — Utilization of Plant Capacity

Capacity utilization rates nationwide and in Tennessee have been distressingly low during this recession — the longest in Tennessee's post-depression history. Recording the greatest agreement on any single issue, nearly 90 percent of all panelists expect plant utilization to be up in 1984. Twenty-eight percent expect moderate to substantial improvement. The comments of three manufacturing executives from West, Middle and East Tennessee, respectively, highlight this issue:

> **Until we achieve better plant capacities, profits and hence development capital will suffer.**

> **Underutilization of plant capacity would make an excellent topic sentence filled with the other 18 items used as adverbs. Private industry needs the help of Tennessee (government, educational, etc.) as Tennessee needs private industry. A weak link in this fragile chain could be very damaging to our economy. The answer is cooperation between Tennesseans: we must listen to each other's needs and offer our expertise.**

> **Underutilization of existing capacity is the key to the high level of unemployment and the low level of business investment in new capacity in Tennessee. The key to this problem is outside Tennessee's control and rests with continual sound economic policy action to reduce the deficit through reduced future spending and higher taxes. This would provide assurance that the present economic recovery would continue and not trigger another inflationary boom and bust cycle.**

Issue #4 – Supply of Skilled Workers

This is the fourth-ranked issue of concern to the panel. Despite this concern, there is no great expectation that the supply of skilled workers will be a short-run issue. Forty-two percent of the panel expects no change in scarcity of skilled workers in 1984 when compared to 1983. While 29 percent of the panelists expect skilled workers to become even more scarce in 1984. Panelist comments are pointed, as this sample illustrates:

> **Industrial recruitment will be hurt by the shortage of skilled workers in many communities.**
>
> **With the change in methods used to produce items, more skilled workers will have to be trained.**
>
> **We are not supplying the very high tech talent we are recruiting industry for. We need an excellence center and co-op education programs which will focus on skill needs:**
>
> **Tennessee's labor skill levels are generally low. This discourages the development of higher wages, high-growth industry, whether it is indigenous or imported. In turn, the relatively limited opportunities for highly trained or highly educated labor leads those Tennesseans who do have such skills to leave the state for more opportunities and higher wages elsewhere.**

The Remaining Key Issues

Fifth ranked is the issue of labor-management cooperation, obviously related to unemployment and other top-ranked issues. A clear majority (61 percent) expects labor-management cooperation to be about the same, up slightly or up moderately in 1984. New residential construction in Tennessee, the sixth-ranked issue, is viewed almost optimistically by the panel. Forty-five percent expect construction to be up slightly in 1984 and another 26 percent expect it to be up moderately compared to 1983 levels. Closely related to declining unemployment and the improving economy in general is the seventh-ranked issue, demands for wage rate increases. Sixty-one percent of the panel expects demands to be up in 1984 compared with 1983.

Panelists in the Trade and Finance sectors are distinctly more pessimistic (about interest rates) than executives in manufacturing or the combined service and miscellaneous group

The Least Critical Issues in 1984

Although all nineteen economic issues listed received the same attention from the panel as problem areas, those issues ranked least frequently as problems could be interpreted as economic strengths in the state in 1984.

Strength #1 – Availability of Energy. Availability of electricity, gas, and other fuels are viewed as a strength of the state economy. Fifty-four percent of the panelists expect 1984 energy availability to be about the same as in 1983. Twenty-two percent expect supplies to be up slightly, and another 22 percent up moderately in 1984.

Strength #2 – State and Local Taxes as a Percent of Personal Income. This issue was viewed at low levels by Outlook '84 Panelists. Nearly 30 percent expect taxes to remain the same or decrease as a fraction of personal income. Sixty percent, however, expect slight to moderate increases in 1984, compared with 1983 state and local tax levels. A panelist from Middle Tennessee comments:

> **State funding should be faced as an issue in order to allow business and the individual to know what is expected of them. A substantial increase in spending will not hurt us since on a per capita basis we are low. A clear reform with equitable distribution will take away the uncertainty, allow business to determine its bottom line, and the state to have a more effective revenue base.**

Strength #3 – The Supply of Transportation Services. Sixty-four percent of the panel expects the supply of transportation services and logistics support to remain about the same or improve slightly in 1984 relative to 1983.

Strength #4 – Business/State Government Cooperation. Viewed as an asset in Tennessee, business/state government cooperation is expected to remain stable in 1984 (at 1983 levels) by 52 percent of the Outlook panelists. Another 31 percent of the panel expects business/state government cooperation to be up slightly and 15 percent up moderately in 1984.

Education and the Tennessee Economy

For the past year, Alexander administration initiatives in education have been discussed throughout the state and the nation. Although there is wide consensus that our public schools need to be improved, there is little agreement on details. Within Tennessee the administration, legislature, and teachers associations have tried to develop a comprehensive package to support educational improvement. A special session of the legislature was called to discuss this issue and the revenue necessary to implement changes.

It was in the context of this far-ranging public discussion that we asked our panel about education and the Tennessee economy. Overall, panelists find our public schools about average. Improvement in elementary and secondary education and college and higher education are seen as necessary for economic development in the state. This improvement should be directed primarily toward elementary and secondary education, specifically to basic skills, then to improvements in mathematics and science. Merit pay for teachers has wide support among the panel. Although about a quarter of the participants see no need to increase financial support for public education, the overwhelming majority (71 percent) see increased funding as essential to increased quality. They support a tax increase for education and feel that state expenditures are too low relative to needs. To increase revenue, they favor a general sales tax increase. While this is clearly the most preferred option, there is support for a state lottery, increases in taxes on tobacco and alcohol, and a personal income tax.

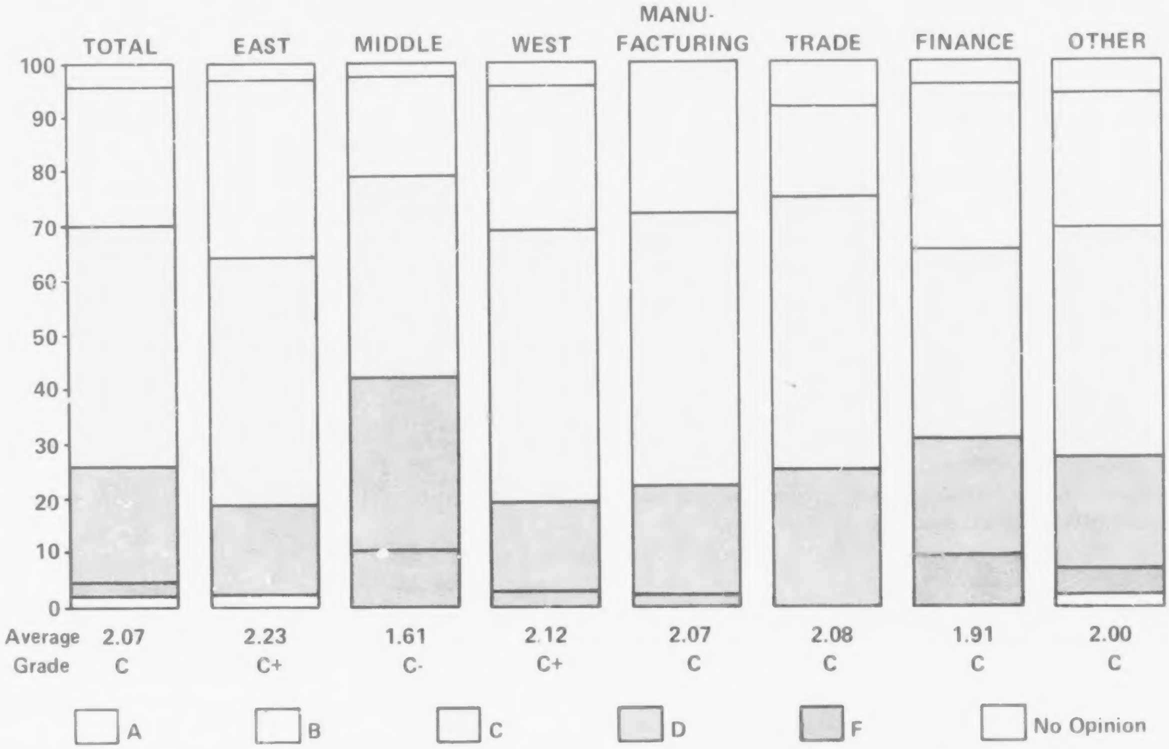
The panel gave Tennessee public schools a grade of C. Figure 3 shows the variation in grade assignment and average grade by geographic region and type of industry. While the differences are slight, it is clear that panelists from Middle Tennessee are less positive about the schools than those from other areas. They issue significantly more D's and F's and far fewer C's and B's than do either East or West Tennesseans. Within the industrial sectors, manufacturing and finance have the least favorable attitudes – manufacturing granting no A's and finance a large proportion of F's. Still, the differences are far less important than the overall notion that our schools get a grade of C, with about 4 percent A's and 26 percent B's. Clearly, the panel feels there is room for improvement.

A Need for Improvement – Back to Basics

Panelists were asked to rank the four most important of 14 areas for improvement of education, and most of these were from the "Better Schools Program" (see Figure 4). It is clear from their responses that there are two areas that receive support from almost everyone, and three others that receive more scattered support.

Improving basic skills was listed by almost everyone: 65 panelists rated it

3 Panelists' Grades for Public Schools
(By Geographical Sector and Type of Industry)



Note: Average grades computed by assigning 4 to A, 3 to B, 2 to C, 1 to D, 0 to F.

4 Panelists' Rank Order for Items Chosen for Better Schools Program*

		Total Points Per Items By Sector							
Item	First Choices	Total	Manu-facturing	Trade	Finance	Other	West	Middle	East
a. improve Basic Skills	65	68	67	52	75	69	71	62	69
n. merit pay	39	55	57	60	55	52	49	61	56
d. increase math & science	9	26	34	17	24	22	29	19	30
c. require homework	5	21	17	15	21	24	20	27	19
i. some computer	0	19	21	25	20	15	19	21	19
g. accelerate	4	12							
e. reduce class size	1	8							
l. increase basic salaries	5	7							
f. lengthen day/year	0	7							
k. part-time instructors	0	6							
b. kindergarten	2	5							
h. libraries	0	3							
j. computer proficiency	0	2							
m. increase math salaries	0	2							

West Tennessee Manufacturer:

> **"Basic skills are basic to a good schools program. This is the area most lacking in schools nation wide."**

East Tennessee Tradesperson

> **"Industry has proven you only get excellence with pay for performance."**

*Based on 4 for First Choice, 3 for Second, 2 for Third, 1 for Fourth. Number is percentage of all Possible Points (4 times number of respondents)

first, and only 24 excluded it. This score understates the emphasis on basic skills because some panelists checked other alternatives which they saw as equivalent to basic skills. As a panelist from Middle Tennessee put it:

> **I was not sure in (a) what you mean by 'basic skills,' therefore I chose (d) as being closest to reading, writing, arithmetic and science.**

Panelists who did choose "basic skills" as the most important area for improvement showed in their comments that they were thinking of practical everyday skills.

A Middle Tennessee manufacturer:

> **The basic skills of everyday living are lost, i.e., command of English, the ability to fill in an application, read a newspaper, balance a check-book.**

An East Tennessee tradesperson:

> **Many graduates are not able to compose a relatively simple letter.**

Evidently, employers across Tennessee find that students from our public schools have trouble filling out job applications and performing other tasks required for routine participation in the society. They also see basic skills as an essential foundation for any and all advanced training and education.

A West Tennessee manufacturer:

> **The basics are very important as a building block for higher education and/or specialized education and severely restrict continuing education unless in place.**

Some are adamant that improvement in basic skills is so important that students should be required to master these skills.

A Middle Tennessee manufacturer:

> **Basic skills must be mastered by all public school students – period. If students do not master the basic skills, it should be mandatory that they be required to repeat that particular level until they master it before going on to a higher degree of skills.**

There is strong support for programs to improve the actual performance of graduates in basic skills such as reading, writing, and arithmetic. Panelists would look kindly on well designed "competency-based" education and testing within the public schools.

The second most widely cited area was that of "merit pay" or a "career ladder." Overall 39 of the 176 panelists made this area first priority and only 32 failed to list it as one of the four most important areas. It received 296 points of a possible 536, or 55 percent of the total. Most chose this area because of experience with the relationship between pay and performance of their own workers.

An East Tennessee manufacturer:

> **Merit Pay and/or Career Ladders have worked in industry for years. The best teacher and the worst teacher should not be paid the same. The system should be changed to adequately compensate the better teachers and not let the marginal teachers be tenured for life.**

A Middle Tennessee manufacturer:

> **Pay for performance is a basic tenet of a capitalist society, particularly in the area of reimbursing professionals. If teachers consider themselves professionals, they should be reimbursed in a competitive environment.**

One of the striking findings was that despite a strong push for merit pay there was no sentiment to increase salaries for mathematics and science teachers. This particular salary option was the lowest ranked of the fourteen areas listed.

Of other areas listed, only three had substantial support: (1) Increase the amount of required course work in math and science; (2) increase the level and pace of school work to require homework; and (3) require more computer education for every student. Increased homework is generally part of the stress on basics, but at least one person felt that homework developed good character traits.

A Middle Tennessee businessperson:

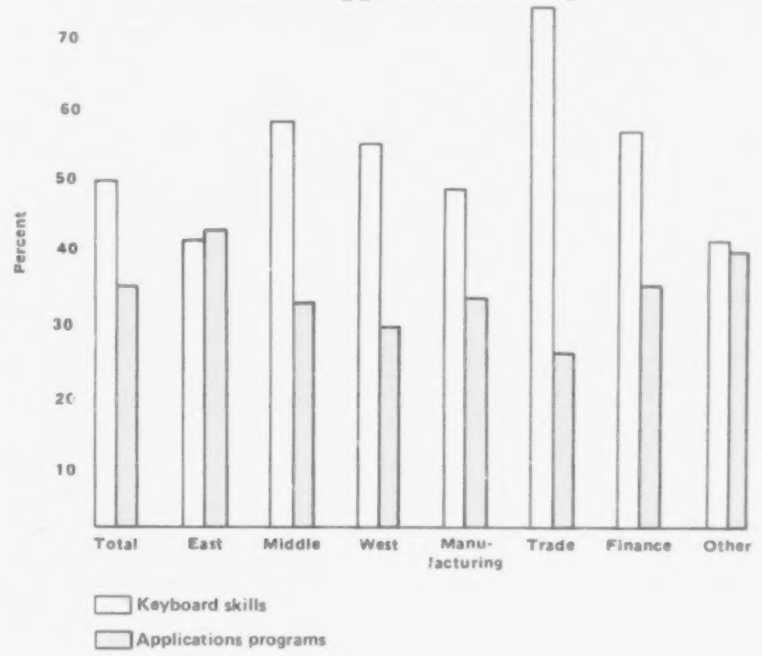
> **Implementation of [increased homework] would eventually benefit all society by having instilled a basic character discipline.**

There are no significant differences of rank order by geographic area or organizational sector. Thus, the composite view of educational improvements stresses improvements in basic skills and merit pay for teachers and then improvement of competence in mathematics, science and computing.

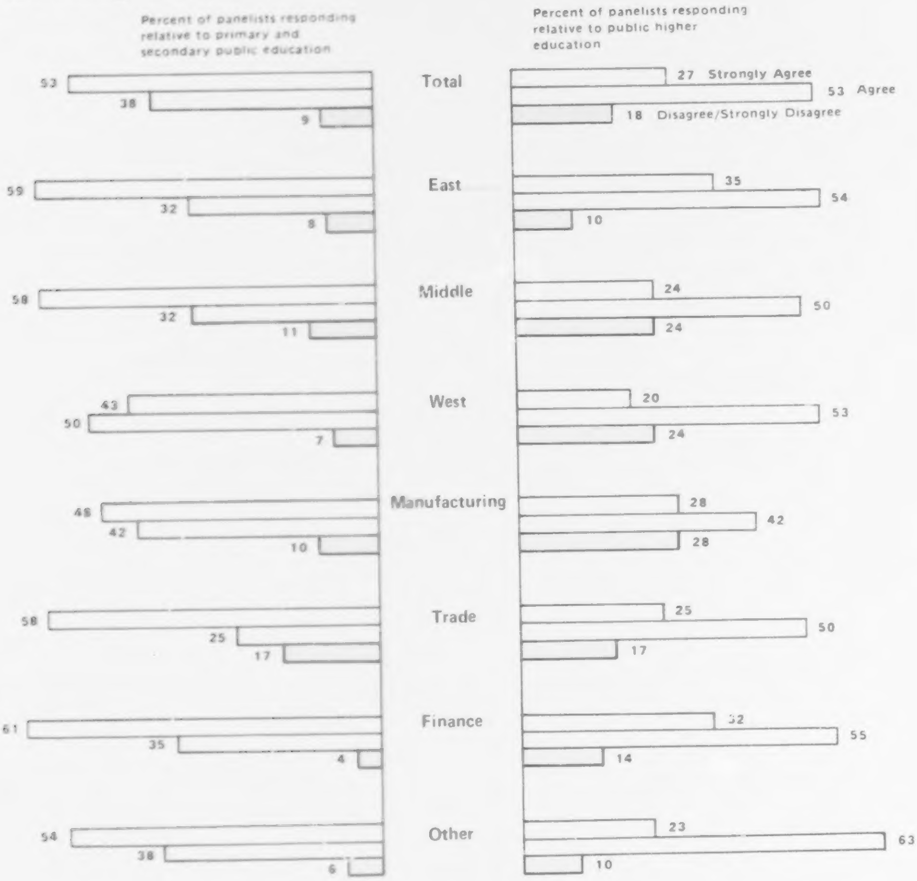
Part and parcel of the emphasis on basic education and science is the definition of "computer literacy" as primarily keyboarding skills (50 percent of all respondents) or ability to use applications programs or software packages (35 percent of all respondents). About 6 percent of all respondents felt that literacy required the ability to write programs, and about 3 percent felt that literacy required no skill beyond the use of educational games. Another 6 percent suggested options not mentioned in our list which ranged from writing programs to use of applications, to keyboard skills, to educational games. Consensus is widespread across all areas and sectors, as can be seen from Figure 5. The figures for the trade sector are suspect because of the small numbers involved. Only in East Tennessee is there substantial sentiment that literacy should stress ability to use applications more than keyboard skills. Thus, while there is broad agreement, East Tennesseans appear to want a slightly higher level of training. It seems safe to forecast that more advanced computer training will be required in the future. School systems would do well to instruct people in the use of applications packages and other software and to think of this as the most acceptable level of training.

Panelists generally agree that failure to improve the quality of public education will hamper economic development in the state. Support is much stronger for improvements in elementary and secondary education than for college and graduate education. About 91 percent of the panelists "agree" or "strongly agree" that improved public schools are essential for development and about 80 percent that improved higher education is essential. In addition to this slight difference, the ratio of "agree" to "strongly agree" responses is about reversed (53 percent "strongly agree" for public schools and 53 percent "agree" for colleges). Patterns of support are seen graphically in Figure 6. Deviations are relatively slight, and the only ones of note are that East Tennessee panelists support improvements in higher education more than those from other regions, and support from manu-

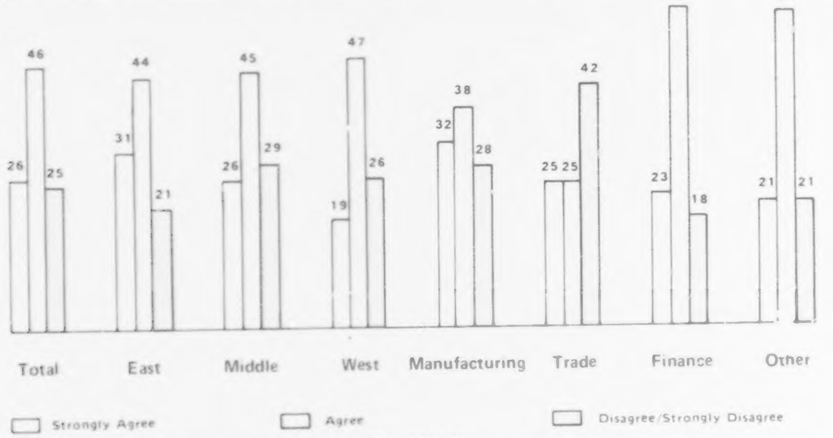
5 Percent of Panelists Who Define "Computer Literacy" as Keyboard Skills Or Use of Applications Programs



6 Patterns of Support for Statement that Failure to Improve Quality of Public Schools Will Hamper Economic Development



7 Patterns of Support for Statement that Increasing Financial Support for Public Schools is Essential to Quality of Education



Data shown are percentages of total panelists grouped as specified.

facturers is slightly weaker than that from other sectors.

There is general support for the statement that increased financial support for education is required if we are to improve quality. Once again, fluctuation by geographic area or employment sector is less important than the overall pattern (Figure 7). In this respect, there are about as many who disagree as those who strongly agree. About a quarter of the panelists disagree with the need to expend more money.

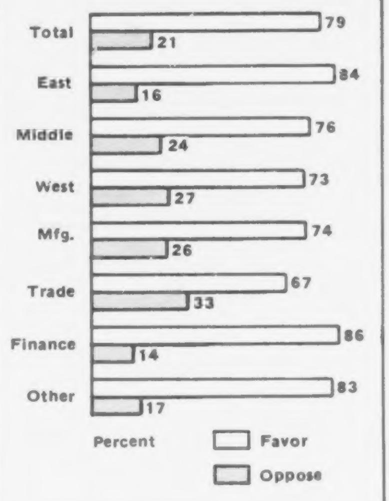
Those who agree that increased spending for education is essential to increasing quality of education will also support an increase in state tax levels (Figure 8).

If revenues are to be increased, there is no choice from the list in Figure 9 that is supported by a majority of the panelists. Still, there is a clear preference for increasing the state sales tax. Following that, there is a group of three choices which commands equal support: a state lottery, increases in tobacco and alcohol taxes, and a personal income tax. Tradespersons are for increases in tobacco and alcohol taxes and not in favor of an income tax. Professionals and service industry persons prefer personal income taxes to other choices. East Tennesseans are slightly more favorable to the income tax and less to the lottery. Despite these differences, one is impressed with the overall similarity of the ranking of potential revenue sources.

In our questionnaire, panelists were provided data about the federal budget for 1982 and given estimates for 1984. Budget analyses, based on the **1983 Economic Report to the President**, listed actual dollar figures, percentages, and the growth in the deficit. Categories provided to the panelists are shown in Figure 10.

In general, panelists support the Reagan administration, saying that federal expenditures are too high relative to national needs, and that deficits need to be reduced through a combination of tax increases and budget cuts, with tax increases to come primarily from consumer taxes and lastly from social

8 Panelists' Views On Tax Increase



"Those who agree that increased spending for education is essential ... will also support an increase in state tax levels."

9 Rank Order for Additional Tennessee Revenue Sources

Tax	Total	East	Middle	West	Manu-facturing	Trade	Finance
a. General Sales	1	1	1	1	1	2	1
e. State lottery	2	2	2	2	1	2	2
i. Tobacco	2	2	2	2	2	1	2
b. Personal Income	2	2	2	2	2		
c. Gasoline							
g. Severance							
j. Single business							
f. Corporate income							
h. Franchise							
d. State property							

Highest Scores
Second Choices

10 Federal Receipts, Expenditures and Deficit

Actual Fy 1982 and Estimated 1984

	Actual FY 1982		Estimated FY 1984	
Federal Budget Categories	**$ billions**	**Percent**	**$ billions**	**Percent**
Receipts				
• Personal income taxes	$297.7	48.2	$295.6	44.8
• Corporate income taxes	49.2	8.0	51.8	7.9
• Consumer taxes	44.3	7.2	49.5	7.5
• Social security taxes	201.5	32.6	242.9	36.8
Miscellaneous[1]	25.0	4.0	19.9	3.0
Totals	$617.7	100.0	$659.7	100.0
Expenditure				
• Defense	$187.4	25.7	$245.3	28.9
• Entitlements	360.1	49.5	409.5	48.3
• General Government	109.5	15.0	123.3	13.4
• Debt Service	84.7	11.6	103.2	12.1
Undistributed receipts[2]	(-13.3)	(1.8)	(-22.8)	(2.7)
Totals	$728.4	100.0	$848.5	100.0
Deficit (increase in federal debt)	(-110.7)		(-188.8)	

[1] Miscellaneous receipts include earnings of the Federal Reserve System (about 2/3 of total), estate and gift taxes, and [illegible]

[2] Continental Shelf royalties and other non-tax items.

SOURCE: 1983 Economic Report of the President, Table B-72.

security taxes.

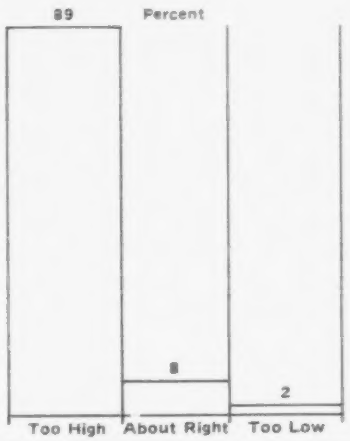
There is overwhelming sentiment (89 percent) that federal expenditures are too high relative to national needs. Fewer than 3 percent said they were too low relative to needs. There is no significant variation by geographic region or industrial sector (see Figure 11).

There is also overwhelming agreement (97 percent) to reduce the deficit. Sixty-three percent would like it reduced dramatically, and 34 percent would like it reduced somewhat. Fewer than 1 percent said the deficit could be larger. While there is somewhat less support for this position in Middle Tennessee, there is no significant variation by geographic region or industrial sector (see Figure 12).

When it came to suggesting how the deficit could be reduced, about one-fifth of the panelists insisted that expenditures be cut without any increase in taxes. Three-quarters said that expenditure cuts should be mixed with tax increases, whereas about half opted for moderate tax increases with large expenditure cuts and one-quarter for a balance of tax increases and expenditure cuts. West Tennesseans, in contrast to others, opted in larger numbers for moderate tax increases and were less likely to choose expenditure cuts without any tax increase. Within the various industrial sectors, financiers differed from the others, with only 13 percent asking for cuts without tax increases (see Figure 13 for details).

While there is general support for some tax increase at the federal level, that support is focused on taxes that provide very small proportions of federal revenue. Panelists generally say that the first source of additional tax revenue should be consumer taxes (taxes on alcohol, tobacco and gasoline, and customs duties). These taxes provide about 7 percent of federal revenues. Another way to look at them is to see that they are about 40 percent as large as the 1982 deficit and about 26 percent as large as the estimated 1984 deficit. To make an appreciable impact on the deficit, they would have to be increased two- to four-fold. Counting four points for a first choice, three for second, two for third and one for fourth, choices for increasing consumer taxes get 82 percent of all possible points. Corporate and personal income taxes share second choice, with 62 and 61 percent of all possible points. Social security taxes get 37 percent of the possible points. There is no significant variation by geographic region or industrial sector.

11 Federal Expenditures Relative To National Needs



12 Panel's View on How to Handle Federal Deficit

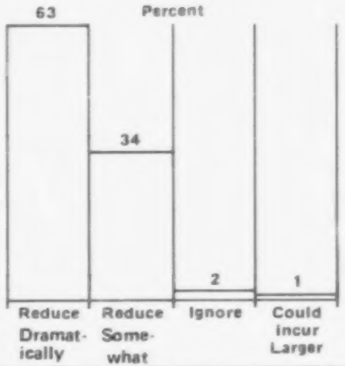
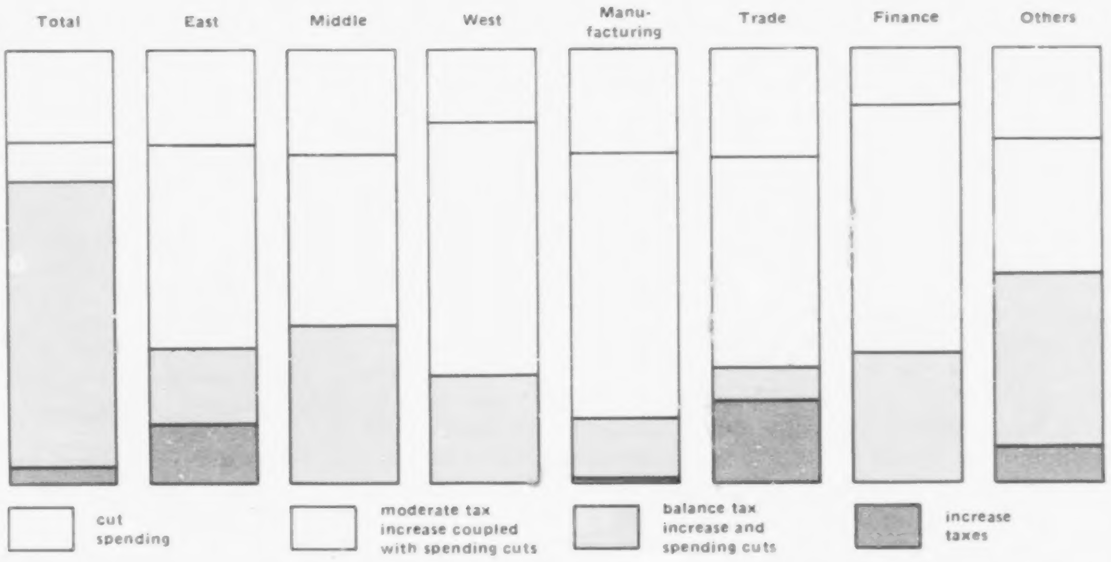


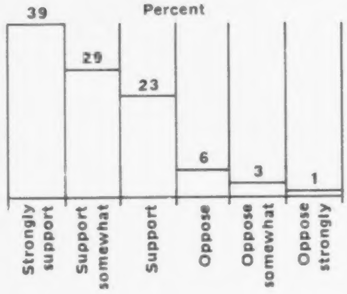
Figure 14 shows support for the Reagan administration. It is clear that support is strong and general: 91 percent say they support the administration. This support is somewhat weaker in traditionally Democratic West Tennessee as well as among financiers and others, but no group provides less than 83 percent support for the administration.

Panelists were asked to indicate priorities for budget cuts and budget expansions (or areas to cut only as a last resort). The questionnaire provided too much detail. As a result many panelists (about 70 percent) gave priorities within each major category: defense, entitlements, and general government: the remainder chose three priorities from the list shown in Figure 15.

13 Panelists' Suggestions for Reducing Deficit



14 Panel's Attitudes Toward Reagan Administration

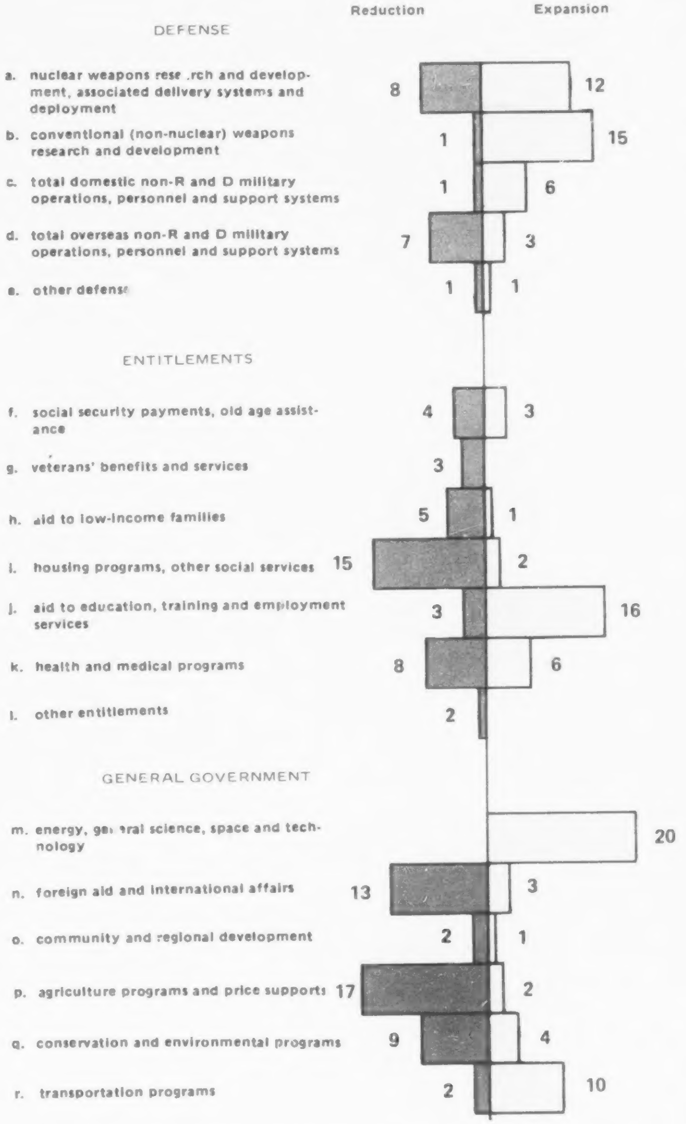


Reduction priorities are for agriculture programs and price supports, housing and other social services, foreign aid, conservation and environment programs, nuclear weapons, health and medical programs, and overseas military expense. Cuts are centered upon general government expenses and entitlements. It is surprising that with the rich agricultural tradition of Tennessee, this area has the highest priority for budget cuts. Expansion (or last-resort cuts) priorities are energy, general science, space and technology, education, conventional weapons, and nuclear weapons.

The panel is clearly polarized on the issue of nuclear weapons. It is fourth for expansion priority and fifth for reduction priority. The only other item which shows similar polarity is health and medical programs. For the most part, Figure 15 shows that items ranked high for reduction are ranked low for expansion and vice versa.

Priorities confirm the general support for the Reagan administration, even as they show somewhat different emphases. Overall, defense expenditures are the least reduced and most expanded. Entitlements are the least expanded and a close second to general government for the most reduction. The picture is consistent throughout geographic regions and industrial sectors. ■

15 Panel's Choices for Budget Reduction And Expansion Priorities*



*Data shown for Reduction Priorities and Expansion Priorities are percentages of total weighted ranks assigned for each category.

David A. Hake, Director of the Center for Business and Economic Research and Research Associate Professor at the College of Business Administration, The University of Tennessee, Knoxville, has participated in the Outlook Panel Project since its inception.

Donald R. Ploch is Research Professor at the Center for Business and Economic Research and Professor of Sociology at The University of Tennessee. He is currently studying the location of firms in Tennessee and the problem of dislocated workers in the Upper Cumberland Development District.

David A. Hake and Donald R. Ploch

1984 Panelists Comment

West:

A CONSULTING ENGINEER: Tennessee has experienced a moderate rebound from the recessionary periods of 1981/82. I expect that this rebound will continue throughout 1984 at a lesser rate. My biggest concern is that the massive federal debt and the possibility of tax increases and higher interest rates may substantially and suddenly reduce consumer confidence and spending for housing, autos, and major items of expenditures. Perhaps the greatest strength in the present economy is the availability and moderating cost of energy. I believe this will continue throughout 1984, resulting in continuing improvement in the rate of inflation.

A FOOD INDUSTRY EXECUTIVE: The economy will show a steady growth in 1984. The farming sector will show substantial improvement, and this helps to improve all support industries. Garment industries could show some weakness caused by imported goods, if not controlled.

A CONSTRUCTION SUPPLIER: Our weakness lies in the tough climate in general for new profit centers, high interest rates for long-term financing, and the difficulty in coming up with a profit after all the bills are paid. This climate is not peculiar to Tennessee alone. Besides the sabre-rattling of our administration, the chief economic concern is the specter of default by Central and South American countries on the billions in loans owed our large banks. We should insist on these banks charging off some of these loans annually or we should stop our contributions to the International Monetary Fund.

AN AUTO INDUSTRY SUPPLIER: Tennessee's economic outlook for 1984 will follow the same trend as the nation—up and good. We have an abundance of energy and an economic environment for individuals and industries, which is very attractive. We have a definite shortage of skilled labor, but have educational facilities intact to handle this deficiency as the need arises. We need to go out and lure more economic investment in the state. Also, improving transportation systems is a must.

A BANKER: The economic strength of Tennessee will depend on the willingness of capable, competent, and persistent people that can and will adjust to keeping up production and paying increasing taxes, despite declining net earnings. The weakness is the result of the reverses of financial institutions, including those that failed and those that made poor loans, took losses, and now feel less secure on their good loans. Careless loans now swing to overcautious lending.

A MACHINERY MANUFACTURER: Our state is today more than ever before in an extremely positive position with the added industries in the past five years. Our current programs continue to attract industry; however, we should be very careful to continue a well balanced program. This is our strength today and for the near future. Our greatest weakness today is in the areas of training our future managers, employees, housewives, etc.

A FINANCE INDUSTRY EXECUTIVE: I think as long as we have over a two hundred billion national deficit, it will be difficult for any state to have economic gains. We cannot continue to spend more than we take in. Some day the books will of necessity be balanced.

Middle:

A CONSTRUCTION EXECUTIVE: Tennessee needs innovative agricultural advances in labor-intensive areas for which our soil, climate, and water supply are suited. Tennessee also needs more small industries. Based on its inherent strengths, Tennessee is basically a "different" state, but Tennesseans have never capitalized on our strengths. With labor management cooperation we can get more Nissan plants but more importantly with business-government-agriculture cooperation we can develop our small strengths. Until the time Tennessee looks inward, it will continue backward economically.

A TOURISM EXECUTIVE: My biggest concern now about Tennessee growth is our state government's apparent obsession with being in large foreign investment.

AN ELECTRONICS EXECUTIVE: Governor Alexander's program to bring industry to Tennessee is a great plus. His program to pass a "merit pay" incentive for improved teachers or superior teachers is a wonderful thing for the people of Tennessee.

A GOVERNMENT EXECUTIVE: I believe Tennessee's economic outlook in 1984 will be very bright, with substantial growth in most sectors of the economy. Our strengths appear to be in our good business climate, good employee-management relations, and in our people's work ethic. Our major weakness stems [from] the lack of basic skills education being provided to our youth. Most industries can provide job training, but the employee must have basic skills with which a company can work.

on the State of Our State

East:

AN AGRICULTURAL ECONOMIST: The economic area of most concern is the agricultural area, including production agriculture and agribusiness. Overall, the corner is nearly turned for those who have followed more conservatively oriented effective strategic planning, aggressive marketing strategies, and financial programs.

A FOOD INDUSTRY EXECUTIVE: All levels of public education must be improved. Special educational emphasis must be placed on training employees in transition from heavy industry to services and higher technology, information, etc. Government and business form meaningful alliances to improve economy on a long-term basis.

A CONSULTING ENGINEER: Tennessee has still not moved into the expanding high technology arena and probably will not, hence growth is dependent upon the low skill industries. This is not the national growth area, hence Tennessee will have difficulty holding its own.

A BANKER: As the nation's economy improves, Tennessee's economy will follow suit. We are much more heavily dependent on automotive and construction industries than many realized before 1981, but these industries are rebounding nicely, which will benefit Tennessee. My only real concern is the level of interest rates and the negative impact high mortgage rates have on housing starts. If the economy booms and rates rise too much more, the housing industry could suffer.

A PUBLISHER: One of Tennessee's strong points is that there is no state income tax! This encourages more growth because the cost of living is within reason. I think we are weak in the area of aid to the elderly.

A BANKER: Tennessee's economy should be improving in 1984 because of the (general economic) recovery. Tennessee's strengths are its low taxes, relatively cheap labor, location, transportation facilities, and its business – friendly government. Its weaknesses are its inferior education system, level of unionization (as compared to other southeastern states), and its reputation for being unsophisticated.

A CONSTRUCTION EXECUTIVE: At age 79, assuming 10 years of life expectancy, I do not expect to see a sustained recovery. Why? Because our citizens will continue to seek political solutions for their economic problems.

A RETAIL ENTREPRENEUR: I am optimistic about the economic condition in Tennessee for 1984. As a small retailer, [I see] this outlook . . . transformed into larger orders for spring, with earlier delivery dates. With stock levels high, if unemployment continues to decrease, the buying attitude will hold. Business should then increase over that of 1983.

A BANKER: Tennessee needs more income, more jobs, higher paying jobs, and more high value-added industries. Tennessee is still too dependent on manufacturing, operations pertinent to yesterday's economy. We must accelerate our change from a basic industrial to an information based economy. An exception will be Nissan and a modern automobile manufacturing complex. Our present labor force lacks the necessary education and skills for tomorrow's economy. We need to raise our standards.

AN ELECTRONICS MANUFACTURER: The overall economy is on the move and should improve Tennessee's overall economic outlook, even though it will come slower than most of us would really like. Improvement in the quality of education to give us homegrown talent to attract new industry is enough of a problem that a definite course for solution should at least be charted in 1984.

AN INSURANCE EXECUTIVE: think the economic outlook is better in Tennessee. The national economy has improved; therefore, we are realizing some benefits. Our strength is our people and our location in the center of major population areas. I prefer educational comparisons on areas (tests, etc.), rather than money spent. I do not feel that spending money is a real indication of how we educate our children.

AN AGRIBUSINESS EXECUTIVE: Tennessee's economic outlook for 1984 will closely parallel that of the nation, on the average. The diversity of Tennessee's economic base is the greatest strength that we have. The greatest danger we face is from adverse effects of continued excessively large federal deficits, and the potential that these deficits will be reduced by moving expenditures for federal levels to the state level in Tennessee. As the economic recovery continues, I have a fear of renewed inflation and thus increased interest rates.

A MANAGEMENT CONSULTANT: Tennessee will become a strong contender for plant location and start-ups. The single biggest factor could be DOE's attitude on technology transfer. If the attitude stays "pro" and the new operator practices it, then we have a chance to echo the spinoffs of the NASA program.

ECONOMIC OUTLOOK FOR

William F. Fox
Richard A. Hofler

The national scenario used in this forecast begins with the assumption that the federal govenment will continue to follow policies that will limit inflation at the possible expense of somewhat higher unemployment during the short run. There are, of course, alternative policies which could be undertaken that would focus more on reducing unemployment in the short run. The actual policies which result over the next several years will be derived from the political process, but we expect little change in the basic direction of federal policy.

The forecast through 1985 is bright. Gross national product (GNP) growth in inflation-adjusted terms is expected to be positive for 1983, 1984, and 1985, and to average over 4.0 percent. 1984 is forecast to be the peak year when output will grow almost 6.0 percent. The national unemployment rate is expected to decrease to 7.4 percent by 1985.4, as employment growth averages about 2.4 percent annually.

The U.S. forecast used here was prepared by Wharton Econometric Forecasting Associates in November 1983. Since that time some data indicating a stronger economy and some indicating a weaker economy have been released. The preliminary report for real GNP growth was 4.5 percent for 1983.4, which was much slower than expected. On the other hand, the U.S. unemployment rate was 8.2 percent during December, much better than expected. So the data, though preliminary, indicate stronger performance for labor markets and weaker output growth. The forecast discussed here is consistent with the 1983.4 GNP growth rate's being a one-quarter aberration from the trend that is expected in 1984.

The current cyclical upturn is reflected most in expectations for the cyclically-sensitive durable goods manufacturing and construction sectors, both of which are forecast to have above-average growth in 1984 and 1985. Service sector growth is also forecast to remain above average.

GNP grew at a seasonally adjusted annual rate of 9.7 percent during the second quarter of 1983 and grew 7.6 percent during the third. These rapid growth rates are not expected to continue over the remainder of the short-term forecast, though from the end of 1982.4 (fourth quarter of 1982) through 1984.4, GNP is forecast to grow a total of 11.9 percent. This is faster growth than the first two years following the 1974-75 recession. GNP growth rates, though remaining positive, are forecast to decline systematically over the next two years.

TENNESSEE & THE U.S.

Given the depth and duration of the recent recession, the expansion may have been expected to be greater. High real interest rates and lagging exports, as a result of the strong dollar, prevent this. Nominal or market interest rates have two components – an inflation premium and the real interest rate. The real component is the important factor for influencing economic behavior. Real interest rates are currently high in response to the Federal Reserve's tight money policies, which are designed to prevent inflation from accelerating as the economy grows (see Figure 1 for recent interest rate behavior). Another reason for high real rates is lenders' concern that inflation will be re-ignited and their unwillingness to allow themselves to be substantially exposed to the risk.

The expectation is that real interest rates will remain high over the short-term horizon and the inflation premium will rise after 1983.4 as inflation rates creep up 1.5 to 2.0 percentage points. Thus, nominal interest rates are expected to increase slightly in 1984. Since history suggests that interest rates tend to fall immediately prior to a presidential election, this assumption is a break from precedent. Interest rates are expected to rise substantially beginning in early 1985.

High interest rates will moderate, though not eliminate, the cyclical expansion of interest-sensitive consumption sectors. Both residential housing and automobile production will proceed at very healthy paces compared with the early 1980's, but activity in each will remain below the high levels achieved in the 1970's. High interest rates are forecast to have the greatest effect on residential housing and to cause housing investment to decline across 1985. This decline in housing is coming particularly early in this expansion.

Business-fixed Investment

Business-fixed investment (the additions to the capital stock) represents the greatest surprise in this expansion. Despite the high interest rates, business firms have indicated a desire to invest at very rapid rates. Fixed investment is forecast to grow nearly 10 percent after netting out inflation during 1984, and inventories are expected to rise

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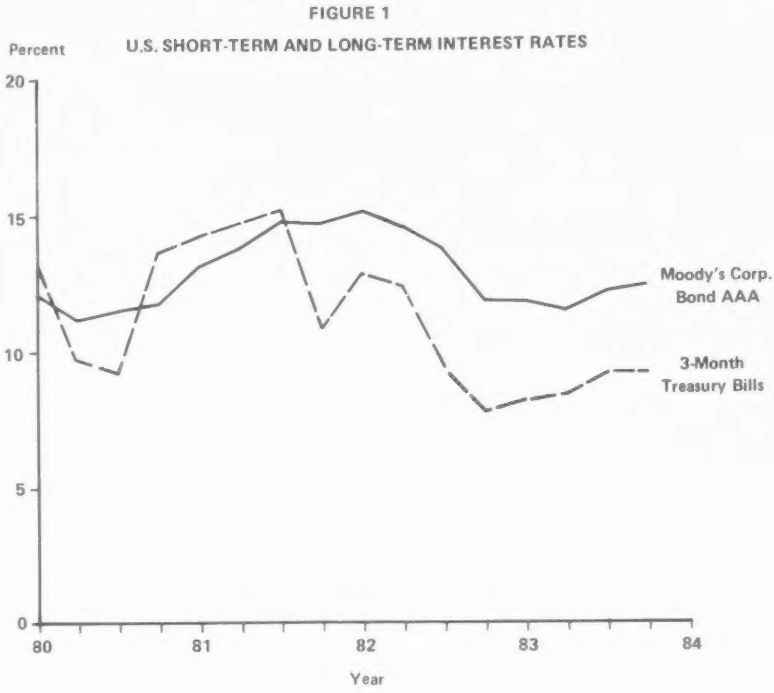
dramatically because firms sold off their inventories during the recession and early expansion and are now trying to rebuild them. Strong investment indicates that the biggest concern by business firms when making investment decisions is profit potentials. Capacity utilization rates are rising and are expected to exceed 84 percent in 1985. With strong consumption behavior expected over the expansion, firms are increasing their productive potential to reap available profits.

The strong U.S. dollar, which is also partly the result of the high real interest rates generated by U.S. monetary policy, is having a negative influence on the expansion. High interest rates attract foreign money capital to the U.S., and the resulting high demand for dollars increases the relative value of the dollar. Uncertainty about economic conditions and relatively weak economic performance in Europe are other reasons for the strong dollar. Exports of U.S. and Tennessee goods are discouraged, and imports of foreign-made goods are encouraged by the strong dollar, so the international sector is a net drag on the U.S. economy. The drain of the international sector will increase slightly in 1984 before beginning to fall in 1985.

Large but declining federal deficits will occur over the next several years. Deficits are expected to remain over $170 billion through 1985. Judgments on whether federal policy is more or less expansionary are based on the direction of change in the deficit, rather than on its level. Therefore, the federal government's influence will be less expansionary (contractionary) over the foreseeable future. State and local governments as a group are also likely to have a contractionary effect, as tax increases will likely exceed expenditure growth for the next several years. State and local governments will probably build surpluses in 1984-85, particularly in their pension funds.

FIGURE 1

U.S. SHORT-TERM AND LONG-TERM INTEREST RATES



SOURCE: Wharton Econometric Forecasting Associates, Inc., historical data.

Despite the fact that federal policy is expected to slowly reduce the deficits, their absolute size may become an increasing problem. By 1985 federal borrowing may begin to compete with business desires for investment. In the face of restrictive monetary policy, this represents potential "crowding out" of business investment by federal deficits. If necessary, the alternative would be for the Federal Reserve to expand the money supply to accommodate the rising demand for loanable funds. Such an action by the Fed, which would re-ignite inflation, seems unlikely.

The result of the above discussion about the various economic sectors is that the cyclical expansion will be supported mostly by consumers and businesses. Government and the international sector will be contractionary. Higher incomes from the federal tax cuts and pent-up demand for housing and automobiles can help consumers sustain the expansion. Business investment will strengthen the expansion, particularly in 1984. The effects of high interest rates and declining federal deficits will likely begin to slow the economy in 1985.

Inflation Rates

Inflation rates are forecast to begin rising in 1984, though the 4.6 percent rate in 1984 remains low, compared with recent history. The rate is expected to rise still further in 1985. The rapid acceleration expected in unit labor costs as the inflation rate rises may be troublesome. If the Federal Reserve envisions rising unit costs as evidence that the inflation rate is rising too quickly, it may choose to slow the growth rate in the money supply further. Lower growth in the money supply could lead to a shorter and less pronounced expansion. Again, we are left believing that the greatest risk in the expansion is that the Federal Reserve will find it necessary to slow money supply growth substantially in order to restrain inflation.

The Tennessee Outlook

As noted earlier, the period 1983.3 – 1985.4 will see a vigorous national recovery during 1984, followed by slower growth during 1985 due primarily to imports exceeding exports and high real interest rates. Consumers will play a major role in the recovery partly as the result of higher disposable incomes (permitted by Federal tax cuts) spent on, among other items, housing and automobiles. High interest rates will prevent demand for these interest-sensitive categories from reaching 1970's peaks. Businesses will also contribute to the expansion as they expand investment and enlarge their inventories. The state's economy will mirror the performance of the nation's economy. Virtually all measures commonly employed to represent the state's economic health (jobs, income, employment, etc.) will rebound vigorously in 1984 and, while still growing, will slacken in 1985 as the recovery weakens and begins to relapse. Furthermore, the state will, in general, grow more vigorously than the nation during the general economic upsurge.

Two of the best measures of economic activity available on a quarterly basis are nonagricultural jobs and personal income. Table 1 shows that Tennessee's nonagricultural jobs will grow in every quarter during the period 1983.3 through 1985.4, rising at an average rate of 1.0 percent per quarter. 1984 will exhibit the largest average annual growth (5.08 percent) and 1985 will see slower growth (3.31 percent). Both will contrast dramatically with the end-of-recession year of 1983, during which jobs actually declined.

Tennessee will mirror the nation's pattern of varying but continual growth in nonagricultural jobs, but will, in general, rebound from the recession at higher rates. For instance, the nation's jobs will grow at an average quarterly rate of 0.8 percent, slightly lower than our state's. In 1984 the U.S., like Tennessee, will see its highest annual growth (3.9 percent), with 1985 being slightly lower (2.9 percent). The peak seasonally adjusted annual growth rate (SAAR: the annual growth rate if the rate of the current quarter continues for three more quarters) for both Tennessee and the nation will occur in 1983.4, and the lowest growth will be seen in 1985.4. However, both Tennessee's peak and low will exceed those of the nation.

Jobs in Tennessee

It seems clear that jobs in Tennessee will follow the pattern of the national recovery which was sketched earlier: 1984 will see peak average annual growth, in general, and 1985 will exhibit the beginning of the slowdown as consumer spending wanes. Tennessee will follow the nation's recovery because it is closely linked to the rest of the country economically. However, it may be unclear why, while following the same pattern, the state will grow at different rates from the nation.

There are two basic reasons for this "same but different" phenomenon. First, Tennessee began this recovery from low levels of jobs because the prior recession decimated our economy. For instance, between June 1979 and December 1982, the state lost over 136,000 jobs out of a work force made up of fewer than two million persons. Second, the state is more cyclically-sensitive than the nation. This means that Tennessee will usually rebound faster than the nation when the national economy improves.

Why these two points are true is answered largely by the difference between the compositions of the Tennessee and national economies. The first phenomenon mentioned above is largely due to our economy's composition during the 1980-83 recession. Figure 2 shows the percentage distribution of nonagricultural jobs in 1981 in both Tennessee and the United States. Two characteristics are very pronounced. First, Tennessee has more concentration in manufacturing than the U.S. (the difference is nearly 7

> "Virtually all measures commonly employed to represent the state's economic health (jobs, income, employment, etc.) will rebound vigorously in 1984 and, while still growing, will slacken in 1985 as the recovery weakens and begins to relapse."

percentage points). Second, our state has relatively fewer services jobs.

Cyclically-Sensitive and Insensitive Industries

Among industries we find both cyclically-sensitive and cyclically-insensitive ones. A cyclically-sensitive industry will exaggerate the rates of change occurring in the national economy. That is, such an industry will grow faster than the nation during a rebound and will slide more precipitously during a decline. Conversely, the cyclially-insensitive industries are more stable and, hence, typically show less volatile rates of change. To the extent that a state's industrial structure is more highly concentrated than the U.S. structure in cyclically-sensitive industries, we would expect that state to suffer more than the average state from a national economic downturn. Figure 2 shows that the state was not only relatively concentrated in the cyclically-sensitive manufacturing industry, but it also lacked the countervailing stability of a nationally comparable percentage of cyclically-insensitive services jobs. In fact, Tennessee was especially concentrated in sectors related to construction (such as manufacturing which was heavily impacted by the recent recession) and in providing inputs to the other durable goods finished products. In nondurables manufacturing, the above-average concentration in apparel manufacturing further damaged Tennessee's relative position during the recent recession. All

QUARTERLY TENNESSEE ECONOMETRIC MODEL
DECEMBER 1983 QUARTERLY UPDATE

TABLE 1: SELECTED ECONOMIC INDICATORS (SEASONALLY ADJUSTED)

	LAGGED	FORECAST-DATA							
	1983.2	1983.3	1983.4	1984.1	1984.2	1984.3	1984.4	1985.1	1985.2
US GNP (BIL 72 $)	1525.1	1553.6	1578.3	1598.2	1619.0	1639.2	1656.1	1671.9	1685.9
% CHG PREV QTR SAAR	9.73	7.69	6.51	5.15	5.31	5.08	4.19	3.88	3.37
% CHG SAME QTR LAST YR	2.40	4.57	6.59	7.25	6.16	5.51	4.93	4.61	4.13
US PERS CON DEFL (1972=100)	212.5	214.4	216.6	219.0	221.7	224.5	227.4	230.5	233.9
% CHG PREV QTR SAAR	4.65	3.62	4.21	4.48	4.99	5.13	5.30	5.52	6.14
% CHG SAME QTR LAST YR	4.37	3.62	3.65	4.24	4.33	4.70	4.97	5.23	5.52
TN PERSONAL INCOME (MIL $)	43743.	44341.	45806.	47348.	48586.	49813.	51005.	52113.	53216.
% CHG PREV QTR SAAR	7.90	5.59	13.88	14.16	10.88	10.49	9.92	8.98	8.74
% CHG SAME QTR LAST YR	6.34	6.54	7.90	10.32	11.07	12.34	11.35	10.06	9.53
TN PERSONAL INCOME (MIL 72 $)	20585.	20682.	21145.	21619.	21916.	22190.	22430.	22612.	22749.
% CHG PREV QTR SAAR	3.11	1.89	9.27	9.26	5.61	5.10	4.38	3.28	2.45
% CHG SAME QTR LAST YR	1.89	2.82	4.11	5.83	6.47	7.30	6.07	4.59	3.80
US PERSONAL INCOME (BIL 72 $)	1277.0	1288.8	1314.1	1329.3	1340.1	1352.0	1364.8	1376.9	1385.8
% CHG PREV QTR SAAR	3.85	3.75	8.07	4.71	3.29	3.62	3.83	3.59	2.61
% CHG SAME QTR LAST YR	1.43	2.90	4.35	5.08	4.94	4.91	3.86	3.58	3.41
TN NONAGRIC JOBS (THOUS)	1665.0	1678.0	1707.7	1731.4	1753.5	1777.7	1798.0	1807.3	1817.9
% CHG PREV QTR SAAR	-0.85	3.14	7.26	5.67	5.22	5.62	4.66	2.08	2.35
% CHG SAME QTR LAST YR	-1.90	0.10	2.62	3.76	5.31	5.94	5.29	4.39	3.67
US NONAGRIC JOBS (MIL)	89.5	90.2	91.3	92.3	93.0	93.8	94.6	95.3	95.9
% CHG PREV QTR SAAR	2.90	3.45	4.93	4.24	3.44	3.29	3.61	2.87	2.61
% CHG SAME QTR LAST YR	-0.54	1.00	2.83	3.88	4.01	3.98	3.65	3.31	3.10
TN UNEMPLOYMENT RATE (%)	11.6	10.6	10.4	9.9	9.3	9.0	8.8	8.3	8.1
US UNEMPLOYMENT RATE (%)	10.1	9.4	8.8	8.7	8.4	8.3	8.0	7.9	7.7
TN MFG JOBS (THOUS)	462.2	469.8	483.9	493.8	500.9	510.0	517.7	518.4	520.3
% CHG PREV QTR SAAR	2.83	6.68	12.55	8.44	5.87	7.51	6.18	0.49	1.53
% CHG SAME QTR LAST YR	-1.54	1.66	5.75	7.57	8.35	8.56	7.00	4.98	3.89
US MFG JOBS (MIL)	18.5	18.8	19.2	19.4	19.7	19.9	20.1	20.3	20.4
% CHG PREV QTR SAAR	5.18	7.02	8.99	5.07	5.07	4.92	4.47	2.79	2.93
% CHG SAME QTR LAST YR	-2.98	0.67	5.21	6.55	6.52	6.00	4.88	4.31	3.77
TN MFG AVE WEEKLY HOURS	40.6	40.7	40.2	39.9	39.7	39.7	39.5	39.3	39.4
% CHG PREV QTR SAAR	4.75	1.34	-5.20	-2.38	-2.64	0.00	-2.05	-1.22	0.61
% CHG SAVE QTR LAST YR	4.91	4.74	2.90	-0.44	-2.25	-2.57	-1.77	-1.48	-0.67
US MFG AVE WEEKLY HOURS	40.1	40.5	40.4	40.4	40.3	40.2	40.0	40.0	40.0
% CHG PREV QTR SAAR	6.24	3.84	-0.77	0.20	-0.74	-1.74	-1.97	0.42	0.20
% CHG SAME QTR LAST YR	2.54	3.67	3.53	2.34	0.62	-0.76	-1.06	-1.01	-0.78

SOURCE: QUARTERLY TENNESSEE ECONOMETRIC MODEL, CENTER FOR BUSINESS AND ECONOMIC RESEARCH, UT-KNOXVIL of this means that, because of the many nonagricultural jobs which were lost due to the cyclically-sensitive nature of our economy, Tennessee began the current expansion at a very low levels of jobs.

Tennessee's forecast higher growth rates (versus the U.S.) are also partially due to this *continued* cyclical-sensitivity of the state's economy. Even if Tennessee and the United States were at the same relative levels of jobs, Tennessee would grow faster as a consequence of our economy's composition. Both points made earlier will be illustrated by the construction sector's performance during the near future. Construction's highest average annual number of jobs (89,200) occurred during 1979. The highest quarterly number of jobs for this sector will be much lower than this peak (81,300 in 1985.3). However, the growth rate during 1984 will average nearly 12 percent, with a peak growth during 1984.1 of 21 percent, both of which will exceed national rates.

			ANNUAL	
1985.3	1985.4	1983	1984	1985
1694.7	1699.3	1536.8	1628.1	1688.0
2.11	1.10	3.46	5.95	3.67
3.38	2.61	3.46	5.95	3.67
237.6	241.1	213.4	223.1	235.8
6.35	6.13	3.95	4.56	5.66
5.83	6.03	3.95	4.56	5.66
54261.	55522.	44202.	49188.	53778.
8.09	9.63	6.72	11.28	9.33
8.93	8.86	6.72	11.28	9.33
22841.	23027.	20710.	22039.	22807.
1.63	3.30	2.65	6.42	3.49
2.93	2.66	2.65	6.42	3.49
1391.2	1398.2	1286.2	1346.5	1388.0
1.58	2.02	2.40	4.69	3.08
2.90	2.45	2.40	4.69	3.08
1829.6	1839.7	1679.8	1765.1	1823.6
2.61	2.22	-0.51	5.08	3.31
2.92	2.32	-0.51	5.08	3.31
96.5	96.8	89.9	93.4	96.1
2.23	1.56	0.39	3.88	2.88
2.83	2.32	0.39	3.88	2.88
7.8	7.8	11.1	9.2	8.0
7.4	7.4	9.7	8.3	7.6
522.2	524.4	468.7	505.6	521.3
1.43	1.74	0.17	7.86	3.11
2.39	1.30	0.17	7.86	3.11
20.5	20.5	18.7	19.8	20.4
1.77	-0.39	-0.89	5.98	3.20
2.99	1.77	-0.89	5.98	3.20
39.8	39.6	40.4	39.7	39.5
4.57	-2.60	4.61	-1.76	-0.35
0.45	0.31	4.61	-1.76	-0.35
40.0	40.1	40.1	40.2	40.0
-0.40	1.01	2.97	0.27	-0.48
-0.44	0.30	2.97	0.27	-0.48

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Nominal Income

Table 1 shows that Tennessee's nominal income will rise sharply from $44,341 million in 1983.3 to $55,522 million in 1985.4 at annual rates of 11.3 percent in 1984 and 9.3 percent in 1985. These rates correspond to a growth of roughly 2.5 percent per quarter over the next ten quarters.

Another reflection of the pattern of the recovery is seen in the performance of constant-dollar personal income. We have discussed how nonagricultural jobs in both Tennessee and the United States will grow fastest in 1984. Personal incomes will also show peak growth rates during 1984 as people go back to work at increasing rates and in growing numbers. More jobs and more people working means, of course, more money being earned in the state. After accounting for the effects of inflation, we will see generally higher growth in the near future and moderating growth later. Constant dollar income will rise at annual rates of 6.4 percent in 1984 and 3.5 percent in 1985, both of which will exceed U.S. growth rates. Contrasting these rates with virtually no growth in 1980 and a decline of 0.5 percent in 1982 indicates how robustly the economy will be recovering from the prior recession.

As with jobs, the cyclically sensitive nature of Tennessee's economy is evident in income's behavior. Constant-dollar personal income in Tennessee will grow at an average rate of 1.2 percent per quarter, while the nation's income will rise at 0.9 percent per quarter. Consistent with this relationship is the fact that Tennessee's income growth will exceed that of the U.S. in eight of the ten forecast quarters.

An examination of the components of Tennessee's nominal personal income carries an interesting message about who will be benefitting relatively more during the current recovery. During 1983, proprietors' income rose at a rate (16.7 percent) which exceeded those of the other four main components (wages and salaries, other labor income, rent and interest dividends, and transfer payments). This is because proprietors typically reap the benefits of economic recovery first. In fact, the highest single quarterly growth rate is the over 23 percent which occurred during 1983.4 (the early stage of the recovery) for proprietors. Furthermore, the growth of proprietors' income during 1983 was more than double that of wages and salaries (7.2 percent). This is a reflection of weak labor bargaining positions during the end of the recession as well as lessened need to press for higher wages as prices rose relatively slowly. While all five components will show dramatic growth during the short-term, proprietors' income will rise by nearly 3.0 percent per quarter as wages and salaries and other labor income grow by 2.6 percent. This disparity in growth per quarter suggests that the distribution of personal incomes in Tennessee during the near future will be shifting somewhat towards proprietors and away from wage and salary earners.

The number of employed persons in Tennessee will grow from 1.93 million in 1983.3 to 2.07 million by 1985.4, an historical high. The pattern of employment growth again reinforces our belief that the recovery will peak in 1984 and subside thereafter. The percentage change in employed persons over the same quarter last year, an indicator of the trend in employment, peaks in 1984.2 (6.7 percent greater than 1983.2) and falls continuously to 2 percent in 1985.4. This will occur as firms recognize the widespread slowdown in growth in 1985 and slow their own growth by reducing their rate of expansionary hiring.

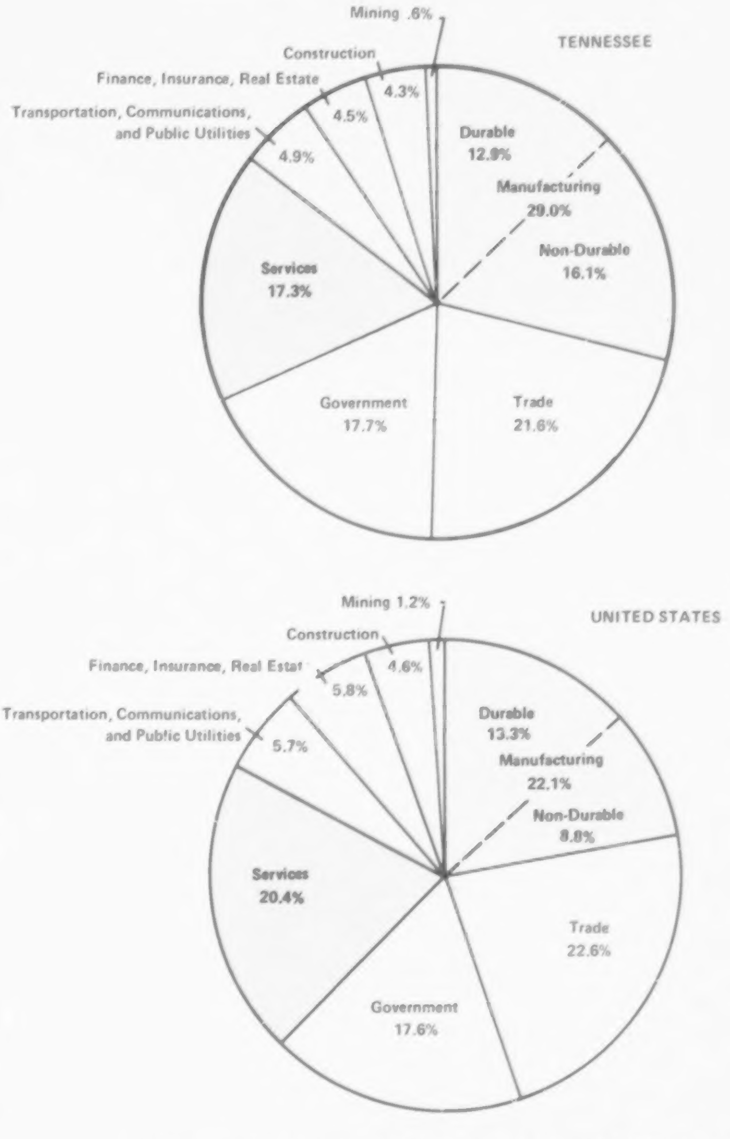
The seasonally-adjusted unemployment rate for Tennessee presents a much more cheerful picture. Although it began the period at 10.6 percent (a legacy of the previous recession), it will drop to below double-digits (9.9 percent) during 1984.1, the lowest it has been since 1981. The unemployment rate will continue to dip to 7.8 percent by 1985.4. Further good news is that, although Tennessee's rate will still exceed the U.S. rate, by 1985.4 the difference will be only four-tenths of a percentage point (7.8 versus 7.4). This incipient convergence reverses the relationship of Tennessee exceeding the nation during 1980-1983, with little narrowing of the gap (see Figure 3). Now, as the figure shows, we can anticipate the imminent shrinking of the difference between the two rates. Furthermore, both the national and state rates are less troublesome than they appear because the lowest attainable unemployment rate (the low inflation and full employment rate) now seems to be slightly greater than 6.0 percent.

The previous discussion of the CLF should somewhat dampen our pleasure at the unemployment rate's performance. We implied earlier that the condition of the CLF is symptomatic of the health of our economy. When Tennessee's economy is expanding, potential job seekers become active seekers and many find jobs. While our economy is shrinking, potential job seekers stay inactive and many others stop looking. From 1984.4 through 1985.4 Tennessee's unemployment rate will fall from 8.8 percent to 7.8 percent. However, the CLF will rise 2.9 percent in 1984, but less than 1 percent in 1985. This says that part of the decline in the unemployment rate may be due to fewer people entering the labor market to seek work and some dropping out of active seeking. In other words, the expected decline in our unemploy-

FIGURE 2

PERCENTAGE DISTRIBUTION OF NONAGRICULTURAL JOBS, 1981

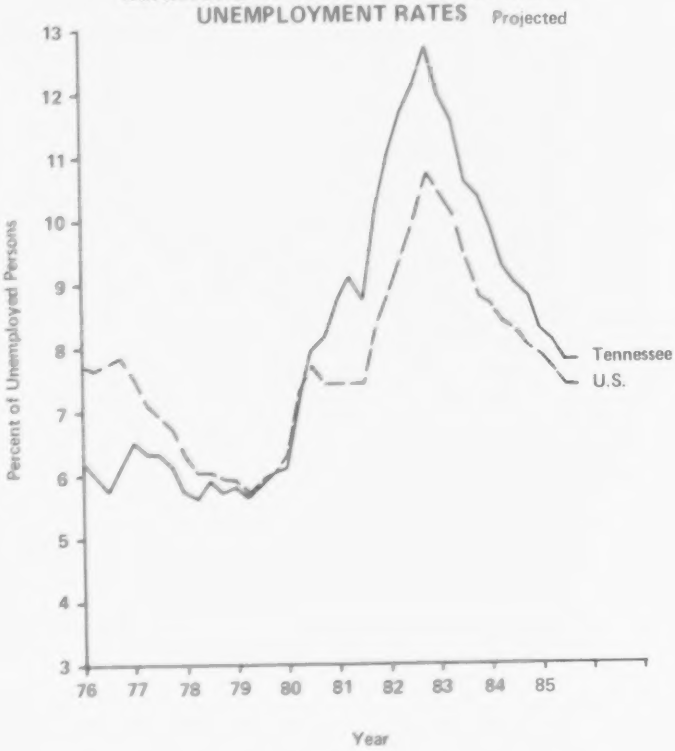
FIGURE 2
PERCENTAGE DISTRIBUTION OF NONAGRICULTURAL JOBS, 1981



SOURCE: Tennessee Econometric Model, historical data November 1983 solution.

FIGURE 3

QUARTERLY SEASONALLY ADJUSTED UNEMPLOYMENT RATES



Source: Tennessee Econc[illegible]tric Model, historical data and December 1983 Solution.

ment rate will not occur totally because of the economy absorbing more and more of those seeking jobs. It may be due, in part, to some people choosing not to seek jobs as the economy slows and they perceive their job prospects diminishing. Thus, the falling unemployment rate will be understating the extent of unemployment because it will be ignoring those who become discouraged and drop out.

Civilian Labor Force

On the other side from the firms and their hiring practices are the activities of the job seekers. The Civilian Labor Force (CLF) is composed of the people who are either working or seeking work. The usual response to worsening economic conditions and, hence, worsening job prospects is for some job seekers to become discouraged and drop out of the labor force (stop seeking work) and for others to postpone entering the labor force (delay seeking work). We saw this "discouraged-worker" response during the recent recession. From 1982.1 through 1983.2 the CLF did not grow at all. In one sense this is a decline in the CLF because it usually grows 1.0 percent or more each year. As the expansion continues during 1984, the CLF will grow at an annual rate of 2.9 percent, reflecting discouraged job seekers who will be encouraged by generally improving job prospects. Conversely, the CLF will grow by *less* than 1.0 percent during 1985 as some people probably sense worsening job prospects and decide not to enter the CLF. However, the CLF will still attain an historically high level by 1985.4 (2.248 million persons). ■

"The unemployment rate will continue to drop to 7.8 percent by 1985.4... [but]... the expected decline... will not occur totally because of the economy absorbing more and more of those seeking jobs... [but] because of some people choosing [illegible]

Economic Forcasting in Tennessee

William F. Fox

David A. Hake

*"Economics is a science of thinking in terms of models joined to the art of choosing models which are relevant to the contemporary world."**

INTRODUCTION

In the past, periods of relatively high growth in markets and increasing revenue have covered many errors in judgment and perception in the public and private sectors. With a relatively slow-growth national and state economy forecast for the foreseeable future, there is much less margin for error in planning direction than at any time in the past two decades. As a partial result, sophisticated econometric forecasting models are being used increasingly at both the national and regional levels.

The Center for Business and Economic Research, in The University of Tennessee's College of Business Administration, developed the first Tennessee Econometric Model in 1974. Now, ten years later in 1984, the tool is perhaps more widely used than it is understood. This article describes the progress that has been made in Tennessee, tells how an econometric model is developed, gives the current status of business cycle and trend forecasting capacity, and explains how the forecasts and data can be of greater service to Tennessee decision makers.

MODELLING TENNESSEE IN A NATIONAL SETTING

The Tennessee economy is closely intertwined with the national economy. Many of the goods which Tennesseans consume have been partially or completely produced in other states or countries, and many of the goods and services that Tennesseans produce are consumed by non-Tennesseans. Obvious examples of this are production of Nissan trucks, Eastman chemicals, and Alcoa aluminum in quantities greater than Tennesseans can consume. Tourists coming into the state provide another way in which locally produced goods and services are consumed by outsiders. These "trade flows" between Tennessee and the rest of the United States (and the world) are so great that the state's economy, in large part, performs according to conditions which exist in the national economy. Recessions will generally occur in the state when they exist nationally, and the same is true for expansions.

Similar, But Not Alike

The Tennessee and U.S. economies are similar, but they are not exactly alike. National fiscal and monetary policies, business cycles, and trends are a dominant concern as we seek to model and forecast Tennessee's economic activity. However, there are special characteristics of the Tennessee economy that cause it to respond differently over time. For example, timing and amplitude of Tennessee business cycles are dissimilar compared to U.S. cycles. Recessions in Tennessee are not necessarily coincident with national recessions. In fact, Tennessee can lag or lead a decline, enter the trough more or less deeply, experience shorter or longer duration, and lag or lead the recovery. Just what the economy will do and when it will do it is, of course, one of the most basic problems facing decision makers at every level. Whether recognized or not, economic uncertainty is the core of most critical business decisions. Probable future levels of product demand, energy prices, interest rates, supplier prices, and wage rates are all related within the same regional economic framework.

Understanding on three levels is required to deal with regional economic uncertainty. The first is an understanding of the structure of the Tennessee economy. The second is an understanding of the structure of the national economy. Adding depth and perspective is the third, and most difficult, level —an understanding of the ways in which these different economic structures are interrelated. The importance of this understanding and the complexity of the task are the principal reasons behind development of the Tennessee Econometric Models (TEM).

TESS

Tennessee as a U.S. Satellite

Any understanding of the state economic structure or forecast of economic behavior must begin with an analysis of national economic expectations. In the case of the Tennessee models, this is achieved by making them "satellites" of the national model developed by Wharton Econometric Forecasting Associates (WEFA). Each Tennessee forecast begins with a macroeconomic scenario prepared by WEFA. The Tennessee model, then, is designed to allocate a share of the forecast national economic activity to the state, particularly for manufacturing. Nonmanufacturing activity is forecast to be determined more by conditions in Tennessee.

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*John Maynard Keynes. Letter to Roy F. Harrod of July 4, 1938 in *The General Theory and After. Part II: Defense and Development*. Vol. XIV of *The Collected Writings of John Maynard Keynes*. Ed. by Donald Moggridge. London: The Macmillan Press, 1973, p. 296.

MACROECONOMIC THEORIES

All models are based on a theoretical conception of how the macroeconomy behaves. Economists subscribe to several different theories, including Keynesian (or neo-Keynesian), monetarist, and supply side. A brief explanation of these is provided here.

Keynesian

The Keynesian model has often been described as a demand-side model. The basic premise is that business cycles are created by fluctuations in aggregate demand, and recessions, in particular, are the result of insufficient demand. Aggregate demand constitutes the expenditures of people, investment by businesses, purchase of goods and services by government, and net spending from the international sector. Recessions occur as lower aggregate demand causes firms to reduce output and lay off, fire, or reduce the hours of employees. Fiscal policy is believed to affect aggregate demand as government *increases* demand by spending more or by reducing taxes on consumers, and *decreases* demand by spending less or by increasing taxes. Monetary policy influences aggregate demand by changing the interest rate, thereby affecting the purchases of interest-sensitive items.

Supply-Side

Supply-side theory concentrates on behavior of individual agents operating in the macroeconomy. The incentives of people to work and businesses to invest and produce are felt to be the key factors influencing the level of output. Government is believed to stimulate production by providing greater incentives for business and workers, not by regulating aggregate demand.

Demand- and supply-side models are not necessarily mutually exclusive. For example, most demand siders would agree that the supply side is important to the economy and is the major factor determining long-term aggregate growth. They differ, however, in that demand siders believe short-term demand fluctuations in the economy are determinants of business cycles. Further, demand siders believe that the degree of responsiveness by business and workers to incentives is less than supply siders have generally suggested.

Monetarist

Monetarists argue that cyclical shifts in output are in response to fluctuations in the money supply. Recessions happen when money supply growth slows and workers' wages grow more slowly. Workers react to lower wages by working less or by seeking new jobs. Monetarists would generally argue that while fluctuations in the money supply cause business cycles, the economy will move to full employment over time. Money supply will affect the price level over the long term, but not the rate of economic growth.

Theoretical Basis of Tennessee Models

The Tennessee Econometric Models are linked to the WEFA model, which is a demand-side model. The WEFA model does incorporate some supply-side factors such as the labor force participation rate of workers, so it can be seen as incorporating elements of these two theories. The emphasis is on demand-side determination of business cycles.

Regional satellite models like TEM derive major assumptions from the macro models, so the basic determinant of the regional forecast will be expected national economic events. The regional model does not directly incorporate any of the macro theories in its structure. The regional modelling problem is to describe the share of national economic activity that will accrue to the region. This is a micro-economic question of how resources are allocated.

SHORT TERM VERSUS LONG TERM

The Tennessee economy is modelled as comprising a share of the U.S. economy, particularly for manufacturing. The share can shift, though determinants of the share are somewhat different for the short term (cycle) and the long term (trend).

Trend Relationships

In the long term, relative cost factors and national directions will prevail in determining Tennessee economic activity. Relative costs refers to wages in Tennessee relative to other locations, taxes in Tennessee relative to other locations, and energy prices relative to other locations. National directions means behavior like the Snowbelt/Sunbelt migration of people and business. The factors influencing cyclical versus trend behavior in nonmanufacturing sectors differ in ways similar to manufacturing.

Cycle Relationships

Short-term or cyclical fluctuations are less the result of cost and trend factors because the time period is too brief for these to take effect. Cyclical fluctuations arise substantially because of the existing industrial structure and the way that structure responds to interest rates and national recessions and expansions.

Two Relationships – Two Models

The different relationships between the national and state economy for trend and cyclical fluctuations and the different factors that influence short-term versus long-term growth lead to the need for two models: a quarterly model and an annual model. The Quarterly Tennessee Econometric Model (QTEM) is used to forecast economic behavior over the cyclical time period of 10 quarters. The Annual Tennessee Econometric Model (ATEM) is employed to forecast economic behavior for the long term, or 10 years. Figure 1 shows the interactions between ATEM, QTEM, and the U.S. economic models. The upper half of the chart is administered by Wharton Econometric Forecasting Associates and the lower half by the Center for Business and Economic Research through ATEM and QTEM. The arrows indicate that the WEFA annual and quarterly U.S. models interrelate with each other. Further, these models provide the national economic assumptions for the Tennessee models. Note that there is no feedback from the Tennessee models to the WEFA models.

The QTEM and ATEM do interrelate with each other. QTEM directly feeds into ATEM as the quarterly model determines the first two to three years of the long-term forecast. The feedback the other way is more subtle and arises because things learned about the structure of the Tennessee economy from development of the annual model also contribute to short-term understanding.

MODEL DEVELOPMENT

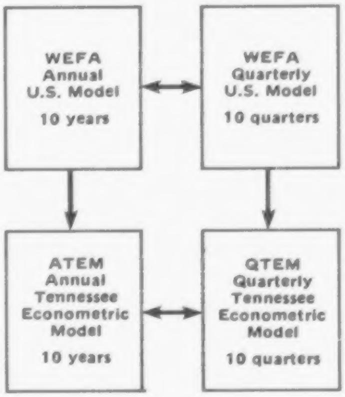
Step 1 – Specification

There are three basic steps to model development: specification, estimation, and validation. Specification involves determining the economic relationships that exist. The goal of this step is to develop a set of economic relationships for each variable to be forecast and the direction in which each relationship is expected to operate. Proper conceptualization is the key here, because errors in identifying the basic interactions will certainly be reflected in future forecasts.

Economic theory is the major factor in specification, as the important relationships are identified and the direction of effects are hypothesized. For example, economic theory is drawn on to provide understanding of what factors determine the number of workers used to produce a certain level of gross state product contribution (output). Economic theory would indicate obvious things, such as, the greater the output, the more workers are needed. Other factors would also be important: wage levels would help determine how many workers are employed as opposed to implementation of other production processes that are more capital intensive. High wages would generally lead to fewer workers, and low wages would lead to more workers. Productivity of workers will influence the number employed, as more workers would be hired if they proved to be more productive. It is not possible to identify every interrelationship; judgement becomes involved to ensure that only the most important interactions are included.

FIGURE 1

RELATIONSHIPS BETWEEN NATIONAL MODELS AND STATE MODELS



Understanding of the institutional and legal framework may be important in the specification stage, which would involve items ranging from legal limitations on bank operations to social security tax rates.

Step 2 – Estimation

Estimation of the model is the second step, with the goal being to find the precise relationships that have existed between economic variables such as output and employment. Estimation requires data on the actual economic events of the past. Statistical techniques like regression analysis are used to measure the past relationships based on the data. At this point, some rethinking of the economic theory often becomes necessary. Some relationships are found to be insignificant in a statistical sense, which may mean that the relationship that was expected to be important has not always been so in the past. Factors that were anticipated to be related in one direction may be related in the opposite direction. Structures must be carefully rethought, insignificant factors must be omitted, and the process continued until an understandable structure results.

An important assumption here is that the historical structure of relationships will also prevail in the future. This assumption may not be valid in every case, and regression analysis will generally lead to only slow shifts in estimated structural relationships. The forecaster's task is to be aware of situations where this may be true and use appropriate judgement later in the forecasting effort.

Estimation is not a one-time process that is then forgotten. New data are available each quarter or each year. Equations must continually be re-estimated to be certain that the resulting relationships reflect current behavior as closely as possible. For these reasons, both ATEM and QTEM are reestimated before each forecast.

The Forecaster's Dilemma

Good quality data are imperative to achieving reliable results in the estimation phase. Care in obtaining data from the best sources and in minimizing errors in collection is necessary, and with this goes an understanding that historical data are not constant. Many nationally available data sets like gross national product or personal income are revised periodically. The revisions may not be only for the most current time periods. Because of improvements in statistical techniques or a change in underlying definition, data revisions may go back many quarters or years. Thus, the data used in earlier estimations may be judged as partially incorrect, necessitating re-estimation of the equations.

Consider the case of gross national product data for one particular quarter. During the quarter itself a "flash" estimate is released. After the quarter ends, a "preliminary" estimate is released which is superseded in a month by the first "revised" estimate. Further official "revisions" are frequently made pertaining to this same quarter up to a year later. Although changes from one revision to another can be large, they are typically relatively small. Nevertheless, the realization that economic history is subject to such change comes as a surprise to the uninitiated. This property of economic data is especially troublesome when one tries to evaluate *ex ante*, or after-the-fact, forecasting accuracy of a model. This "forecaster's dilemma" is sometimes characterized as trying to hit a moving target from a shifting platform.

Step 3 – Validation

The final step in developing a model is validation, which is concerned with judging how well a model forecasts. This is perhaps the most difficult phase of model development. Model performance is generally evaluated based on how well the model would forecast over some portion of the historical period. This fails to be an adequate test because it will probably fail to measure, or will inadequately measure, structural shifts in the future. This technique is limited also because error in a forecast arises from the model structure and from national assumptions incorporated in the model. Evaluating performance using historical data measures only error arising from the model structure, because actual rather than forecast values are used for national assumptions.

Ex Ante Forecast Accuracy

Performance in forecasting future economic behavior is also used to judge models, but this obviously requires a substantial number of periods of forecasting. Recent analysis shows that error in forecasting nominal personal income one year in the future using the Annual Tennessee Econometric Model, (ATEM) averaged 1.9 percent from 1974 through 1983. Error in forecasting employment in terms of nonagricultural jobs one year into the future averaged 2.0 percent over the same time period.[1] These errors are well below the average *ex ante* error experience in a study of four-state forecasting models.[2] There, a one-year average error of about 3 percent on the major variables, such as total state income or employment, was suggested as reasonable, given the "noise" inherent in the data. In another study conducted with a national forecasting model, the observation was made that the error attributable to forecasting was comparable and sometimes less than the variability in actual data measurement from the early estimates to later revised estimates.

> In the long term, relative cost factors and national directions will prevail in determining Tennessee economic activity. Short term or cyclical fluctuations arise substantially because of the existing industrial structure.

The Specification, Estimation and Validation Cycle

Each phase of model development interrelates with the others. Validation may lead to the conclusion that the model forecasts poorly and specification and estimation must be rethought. As already mentioned, estimation leads to some rethinking of specification. Thus, model development will continue throughout the model's life.

MODEL OPERATION

Forecasting

Forecasting begins with a model developed using the best specifications, the most recent data, and the most recent estimation of the equations. Assumptions must be added about factors not estimated in the model structure. National economic forecasts constitute the most important assumptions in ATEM and QTEM. Assumptions must also be made about other factors decided outside the economic system, such as Tennessee tax rates.

An initial forecast is made using the assumptions, estimated economic structure, and current data analysis. Judgement is added to this whenever the forecaster believes the equations fail to reflect some shifting relationships or when some portion of the U.S. assumptions are felt to be too optimistic or pessimistic. The role of judgement cannot be understated; in fact, it is accurate to say that models do not make forecasts; people do. One analyst recently estimated that a forecast is generated 70 to 80 percent from the model and current data analysis.[3] That leaves 20 to 30 percent which is judgement.

Forecasts with QTEM are prepared each quarter as more data about recent economic history become available and new information is procured on the U.S. economic climate. The forecast is extended one quarter further into the future each time. ATEM forecasts are made twice yearly, and a one-year extension in the forecast horizon is made every other time.

Structure of ATEM and QTEM

ATEM is composed of more than 230 equations and QTEM, of more than 160 equations. A detailed description of the models is not possible in this setting. Instead, an overview of the variables forecast and the sectoral detail is discussed here.

More Detail Aids Planning

ATEM and QTEM each contain substantially disaggregated detail for variables which are forecast. This is done because more disaggregated models allow more data and information for users. Disaggregation also allows a close linkup between economic relationships. For example, more finely tuned relationships can be found by measuring the way Tennessee output in the paper industry is affected by U.S. paper output than by trying to measure a relationship between total Tennessee and U.S. manufacturing output. Such industry-level economic relationships do lead to an improved model for measuring interrelationships within the economy. Although offering greater opportunity to interact with planning efforts, disaggregated models do not necessarily have improved forecasting capabilities.

Despite the disaggregation within the models, substantial diversity may remain within any given sector. The detail used in the model is often at a level described as "2-digit Standard Industrial Code (SIC)." Each firm is classified in one 2-digit SIC by the U.S. Office of Management and Budget, despite the fact that it may produce widely different products. The categorization across a 2-digit SIC industry can also be wide.

The Annual Tennessee Econometric Model – ATEM

Figure 2 is a schematic representation of ATEM. Gross state product (output) is the driving sector of the model as it is closely linked to national economic activity and is responsible for partly determining other sectors. As evidenced by the arrows, though, the other sectors feed back into output and each other so that each part of the model is simultaneously determined with the rest.

Figure 3 lists the major variables forecast and the sectors for which they are forecast in ATEM. Output and wages in nominal and inflation-adjusted terms and jobs are the major variables forecast. Each variable is forecast for all 1-digit SIC industries (more aggregated than 2-digit) and for 17 categories of 2-digit SIC manufacturing industries.

Extensive detail is included in special sectors on personal income, finance and energy. Tennessee personal income is forecast by source, on a disposable and per capita basis, in both current and constant (inflation adjusted) dollars. The Finance sector includes forecasts of major categories of assets, liabilities and yields for Commercial Banks and Savings and Loan institutions. A large energy sector includes data on consumption as well as prices for energy by type of fuel (electricity, gas, coal, etc.) and by type of user (residential, commercial, industrial).

The Quarterly Tennessee Econometric Model – QTEM

Figure 4 is the schematic representation of QTEM. Output data are not available for quarters, so employment must be the driving force in the quarterly model.

Figure 5 contains the list of major variables and sectors for QTEM. The fact that data are less available for quarters is apparent in the types of variables represented. Nonetheless, important cyclical variables such as average weekly hours are forecast in QTEM, but not ATEM. Person-hours worked and average weekly earnings are other forecast variables in QTEM that are not available in ATEM.

Sales are forecast for 10 categories in QTEM, and are more disaggregated than ATEM. Among these categories are automobile sales, eating and drinking places, food stores, and hotels and motels.

FORECASTING APPLICATIONS

The ATEM supports longer-term planning based on trend analysis of the state economy. This data can be helpful in strategic planning processes. The QTEM supports short-term planning processes wherein there is a desire or need to evaluate the cyclical component in the economic future. In this regard, the QTEM supports business-cycle-sensitive planning efforts within the likely "trend" of the national and state economies.

Some Uses in State Government

Over the past few years, a number of applications of economic forecasting have been made in the public sector. With current dollar output of $7 billion, direct annual expenditures of about $4 billion, and provision of more than 65,000 jobs, state government is a large and diverse enterprise. Its products, like the skills required for its management and implementation, are as diverse as those of any private sector industry.

The Economic Report to the Governor

The **Economic Report to the Governor**, now in its eighth year, has been prepared annually by CBER staff since 1976. From 1976 up to 1982, the annual **Report** has contained annual Tennessee forecasts based on the ATEM. The current **Report**, dated November 1983, has an annual forecast to 1992 based on ATEM and also a quarterly forecast to 1985.3 based on QTEM. It contains the baseline, control, or "most likely" forecast for the Tennessee economy. A narrative analysis of the state forecast and the national forecast to which it relates is also given in the aggregate, as well as a more detailed description of the forecast for particular industry sectors.

The **Report** has been published each year by the Tennessee State Planning Office. Data contained in the **Report** and **Detail Supplement** have been designated the state's official forecast for internal programming and future budget planning purposes. The **Report** is one part of an overall project which stemmed from a request by key state government officials for help in promoting interdepartmental consistency in planning and budgeting efforts sensitive to the national and state economic environment.

Constitutional Spending Limit

State economic forecasts produced using ATEM and QTEM are used in the implementation of the constitutional limitation on state expenditure growth. In March 1978, Article II of the State Constitution was amended to establish

FIGURE 2

STRUCTURE OF ATEM, THE ANNUAL TENNESSEE ECONOMETRIC MODEL

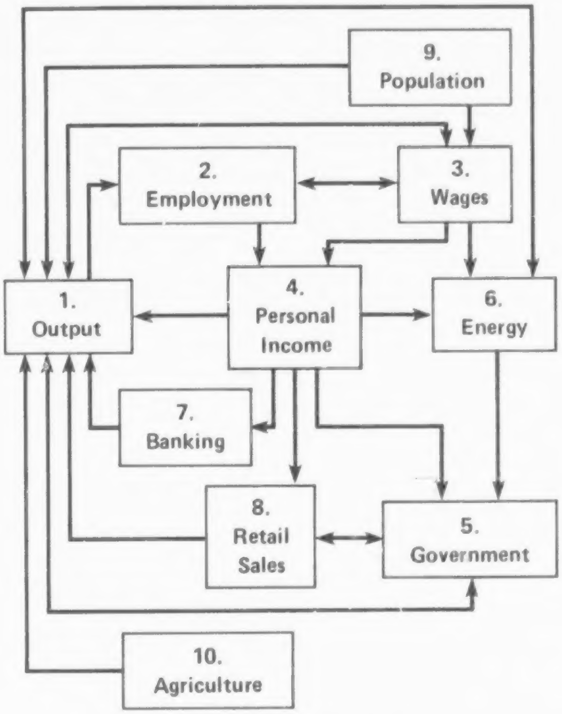


FIGURE 3

ATEM SECTORAL DETAIL

Variables Forecast

Output*
Jobs
Wages*

for

Sectors

Farming
Mining
Construction
Manufacturing
  Lumber
  Furniture
  Stone, Clay, and Glass
  Primary Metals
  Fabricated Metal Products
  Nonelectrical Machinery
  Electrical Machinery
  Transportation Equipment
  Instruments and Miscellaneous
  Food
  Textiles
  Apparel
  Paper
  Printing and Publishing
  Chemicals
  Rubber and Miscellaneous Plastic Products
  Tobacco, Petroleum, and Leather
Trade
Services
Finance, Insurance, and Real Estate
Transportation, Communications, and Public Utilities
Federal Government
State and Local Government

Special Sectors

*Income by source
Bank and S&L – Assets and Liabilities
Agriculture - revenues, output
*Retail Sales – auto and non auto
Population and labor force
Energy – prices and consumption by fuel & by user

*Forecast in nominal and inflation adjusted terms

the policy of limiting growth in state-appropriated out-of-state tax revenues to the estimated growth of the state's economy, except in unusual or emergency circumstances. In enabling legislation (The Tennessee Code Annotated, Section 9-621-624), the Tennessee Econometric Model is specified as one source of the projected rate of growth of the state economy.[4] The approach taken by the state is considered a model by other states considering similar measures. A request from the National Governor's Conference led to a study whereby the ATEM was used with suitable modification to simulate the general economic effects of various spending limit mechanisms, given different economic and fiscal structures of states other than Tennessee. The results were presented at the 1980 National Governor's Conference and other places.[5]

Simulation Forecasting

Simulation, or "what-would-happen-if," use of the Tennessee Econometric Model represents an important feature of the tool. The ATEM or QTEM can be used to generate the environment within which a related, possible firm-specific planning model is operated. The firm-specific model could produce trial cash flow, income statement, and balance sheet information as a consequence of the economic forecast. Various national or state-specific "economic scenarios" could be developed and alternative forecasts produced using ATEM and QTEM. These alternative forecasts then can be used to "drive" related cash-flow or trial balance sheets through the firm's own planning model. Just such a possibility was foreseen by state executives recently, leading to development of an internal planning model for the Department of Employment Security.

FIGURE 4

STRUCTURE OF QTEM,
THE QUARTERLY TENNESSEE
ECONOMETRIC MODEL

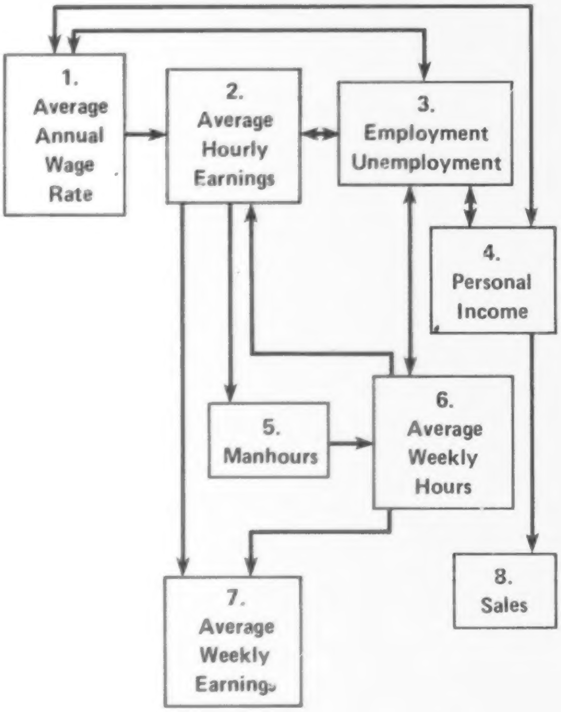

1. Average Annual Wage Rate
2. Average Hourly Earnings
3. Employment Unemployment
4. Personal Income
5. Manhours
6. Average Weekly Hours
7. Average Weekly Earnings
8. Sales

FIGURE 5

QTEM SECTORAL DETAIL

Variables Forecast

Wages[1]
Jobs

for

Sectors

Mining
Construction
Durable Manufacturing
Nondurable Manufacturing
Trade
Services
Finance, Insurance, and Real Estate
Transportation, Communications, and Public Utilities
Federal Government
State and Local Government

Jobs
Average Hourly Earnings[1]
Average Weekly Hours
Average Weekly Earnings[1]
Person Hours

for

Manufacturing Industries

Lumber
Furniture
Stone, Clay, and Glass
Primary Metals
Fabricated Metals
Nonelectrical Machinery[2]
Electrical Machinery[2]
Transportation Equipment[2]
Instruments
Miscellaneous Durable Goods[2]
Food
Tobacco[2]
Apparel
Textile
Paper
Printing and Publishing[2]
Chemicals
Petroleum [2]
Rubber and Miscellaneous Plastic Products
Leather

Special Sectors

Income by source, per capita & disposable*
Retail sales - 10 categories[1]

1. Forecast in nominal and inflation adjusted terms

2. Only jobs are forecast for these sectors, except electrical and nonelectrical machinery which are combined for other variables.

Alternative Forecasts and Satellite Models in Planning

In early 1983, Tennessee's Unemployment Insurance Trust Fund was depleted and the state's insured unemployed were, for a time, being paid with borrowed funds. This in part led to the request for the Center for Business and Economic Research to develop the Tennessee Employment Security Insurance Model (TESIM), a set of about 25 equations which provide quarterly forecasts of trust fund inputs and outputs, depending on the forecast for particular variables in the Tennessee economy. The QTEM is the source of state forecast variables. In model jargon, TESIM is considered a "satellite model" of QTEM because QTEM is the source of its explanatory economic variables.

Under this arrangement, executives in the Department of Employment Security can determine the most probable Trust Fund Balance on a quarterly basis under varying assumptions at either the state or the national level. For example, if a change in a tax rate is being debated in the state legislature, the possible general economic effects could be estimated in a simulation run of QTEM. This "alternative" state forecast could then be used as input for TESIM to estimate the effects, if any, of a change in tax rates on future trust fund inflows or outflows.

THE TENNESSEE ECONOMIC FORECASTING SERVICE (TEFS)

The possibility of enabling applications such as those described above (but in the private sector) and other uses have led to the development of The Tennessee Economic Forecasting Service (TEFS). TEFS is the combination of capabilities of The Annual Tennessee Econometric Model, The Quarterly Tennessee Econometric Model, associated annual and quarterly Tennessee databanks, tailored forecasting seminars, and related interpretive and advisory services.

Two general types of service are available through TEFS – Short-Term and Long-Term. Greater detail on components of both Forecasting Services is provided on page 38.

Long-Term Service

The Long-Term Service uses ATEM to focus on annual data and the longer term trend forecast for the State of Tennessee. The typical forecast, updated twice per year, provides annual data on 240 Tennessee variables for each of 10 future years.

Short-Term Service

The Short-Term Service is designed to sharpen the executive's view of the business cycle planning horizon. The typical short-term, State of Tennessee forecast, based on QTEM, provides data on quarterly economic activity for 170 state variables for each of 10 future quarters. The Selected Indicators Table from the current quarterly forecast is shown on page 26 of this issue. This is one of 38 full-page tables included in a complete Quarterly Forecast.

Suggested Private Sector Applications

Utility of the short-term or long-term forecast service can extend from informal, general economic information use to more formal use in highly integrated internal planning processes. Since state-level forecasts are fully consistent with the national economic environment, they are useful to regional business executives for analysis of products and industries and the economic factors that influence them. Statistical data and analysis in the service will enable business planners to chart how industries and products related to their products or services performed in the past, and how much growth is expected in the future.

Application areas include inventory planning, sales budgeting, and employment planning to complement, rather than fight, the local economic environment. Wage and salary forecasts by industry will aid in setting wage rates and in labor negotiations. Detailed industry-specific historical and forecast data will make it possible for managers of Tennessee branches of national or multi-state firms to get a better fix on Tennessee markets. The continued availability of quarterly updated local forecast data will enable regional marketing plans to be tuned to the actual environment, which may bear little resemblance to the market foreseen by the out-of-state corporate planning staff.

Expansion/contraction decisions for Tennessee operations can be made with greater reliability. Long-term strategic planning can be enhanced as well. Periodic, updated Tennessee forecasts will enable executive review of the local short-term response required to remain on the longer-run track. Through the simulation/consulting services offered, the QTEM or ATEM can be used as a regional tailor for internal planning processes or firm-specific satellite models. Simulation ("what if") studies can be undertaken with the Tennessee Econometric Models upon request.

Where Do We Go from Here?

The Tennessee Economic Forecasting Service is part of a regional research and service program of The University of Tennessee, Knoxville's College of Business Administration, through the Center for Business and Economic Research. As such, there is constant incentive to maintain quality in the regional data system and analyses based on the data. Data are constantly being revised, with model structure and regional needs continuously reviewed.

Possible future areas for model and service extension include development of forecasts for major metropolitan areas of Tennessee, and the capacity to access the model data banks, as well as current baseline and alternative forecasts on a computer time-share basis. Further in the future are plans to develop a capacity for demographic forecasts which are fully consistent with economic forecasts.

It is our hope that increased public and private sector uses of QTEM and ATEM, through the Tennessee Economic Forecasting Service, will lead to more fruitful interaction between those who comprise the economy and those of us who study it.

---

1. "Regional Econometric Models: The 10-Year Record," C. G. Brooking and D. A. Hake, presented at The International Symposium on Forecasting, June 1983, Philadelphia. Multilith copies available from the authors.

2. C. G. Brooking and D. A. Hake, "The Impact of the Regional Econometric Model on the Policy Formation Decision Process," Chapter 19 in *Modeling the Multiregional Economic System*, eds., F. G. Adams and N. J. Glickman (Lexington, Mass.: D. C. Heath and Company, Lexington Books, 1980.)

3. "A Quick Glance at Four Econometric Models," p. 32, in *An Executive's Guide to Econometric Forecasting* (Flushing: Graceway Publishing Company, 1983).

4. The process of development of this legislation is contained in the monograph, "The Constitutional Spending Limitations: . . . The Budgetary Effects of Tennessee's Proposal Nine," K. E. Quindry, et al., Center for Business and Economic Research (Knoxville: The University of Tennessee, June 1979.)

5. Additional results were reported in the Proceedings of the 1981 National Tax Association Conference. A related article concentrating on effects of spending limitations on education expenditures is "The Effects of State-Local Fiscal Constraints on Educational Financing," *Education Evaluation and Policy Analysis*, Vol. 5, No. 2 (Summer 1983). ■

Announcing the Tennessee Economic Forecasting Service...

Tailored Services for Tennessee Executives, Planners and Decision Makers

- Comprehensive, disaggregated Quarterly and Annual Forecasts of Tennessee's economy . . . with selected U.S. forecast data
- Whether your information needs extend
  . . . 10 quarters or 10 years into the future
  Or your analyses require
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The Tennessee Economic Forecasting Service (TEFS) is a subscription-based service which can be used to support long-term and/or business cycle-sensitive planning efforts in such areas as **inventory planning, sales forecasting and budgeting, wage rate negotiations, regional market analysis, expansion-contraction decisions, investment analysis, energy conservation and cost-savings,** and **production planning.** TEFS is the combination of capabilities of the **Annual Tennessee Econometric Model** (ATEM) and the **Quarterly Tennessee Econometric Model** (QTEM), extensive annual and quarterly Tennessee databanks, forecasting seminars, and economic and market-related interpretive and advisory services. Two types of services are available – short-term and long-term. For more information, call or write the Center for Business and Economic Research, 100 Glocker Building, College of Business Administration, The University of Tennessee, Knoxville, Tennessee, (615) 974-5441, or send in the order form at the top of the next page.

KEEP TRACK OF THE BUSINESS CYCLE WITH SHORT-TERM TEFS

Components of the **Short-Term Tennessee Economic Forecasting Service** follow:

a. *Quarterly Economic Forecasts*. Four times each year, 170 Tennessee variables are forecast for each of 10 future quarters. Forecasts for selected national variables are included for comparative purposes. Key variables forecast are shown in Figure 5 on page 36.
b. *Quarterly Executive Summary*. Five to 10 pages of narrative analysis of the current U.S. and Tennessee economy and the forecast.
c. *Quarterly Tennessee Bank*
   - The most recent 10 quarters of updated quarterly historical data for each of the 170 state forecast variables.
   - Complete Quarterly Tennessee Bank available on request. 375 time series.
d. *Quarterly Forecasting Seminars*. Two invitations to each of two seminars per year held exclusively for subscribers.
e. *Consulting Service*. Tailored assistance equilvalent to one day per year of staff time on client-defined problems.
f. *Alternative Forecast Notices*. Alternative quarterly forecasts will occasionally be developed by CBER staff in response to unusual national or state conditions.

HELP DEVELOP AND IMPLEMENT STRATEGIC PLANNING WITH LONG-TERM TEFS

Long-Term Tennessee Economic Forecasting Service components follow:

a. *Annual Economic Forecasts*. Twice each year approximately 240 Tennessee variables are forecast for each of 10 future years. Selected national annual forecast variables are included. Key variables forecast are shown in Figure 3 on page 35.
b. *Executive Summary of Annual Forecast*. Narrative analysis of the current and forecast national and state economy.
c. *Annual Tennessee Bank*
   - Ten most recent years of updated state and selected U.S. historical data in the same format as the forecast.
   - Complete annual Tennessee Data Bank available on request. 450 time series.
d. *Annual Forecasting Seminars*. Two invitations to each of two meetings held per year to present the long-term forecast.
e. *Consulting Services*. Equivalent to one day staff time per year. Simulation services available.
f. *Alternative and Extended Forecasts*. Occasionally, forecasts will be developed as alternatives to the current baseline forecast. This could include a 20-year extended alternative forecast.

TENNESSEE ECONOMIC FORECASTING SERVICE
CENTER FOR BUSINESS AND ECONOMIC RESEARCH

TEFS

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751 pages of facts.

The **TSA** is an economical and efficient reference to information in 19 subject areas for the state as a whole, for Tennessee's Standard Metropolitan Statistical Areas, for each of the 95 counties, and for cities and towns. Tables in each chapter present comparisons of Tennessee with other southeastern states.

Current statistical data is becoming increasingly hard to find and in most cases the user must consult several sources in order to get complete figures. The **TSA** offers respite from what can be a real test of endurance.

C. Warren Neel, Dean
College of Business Administration

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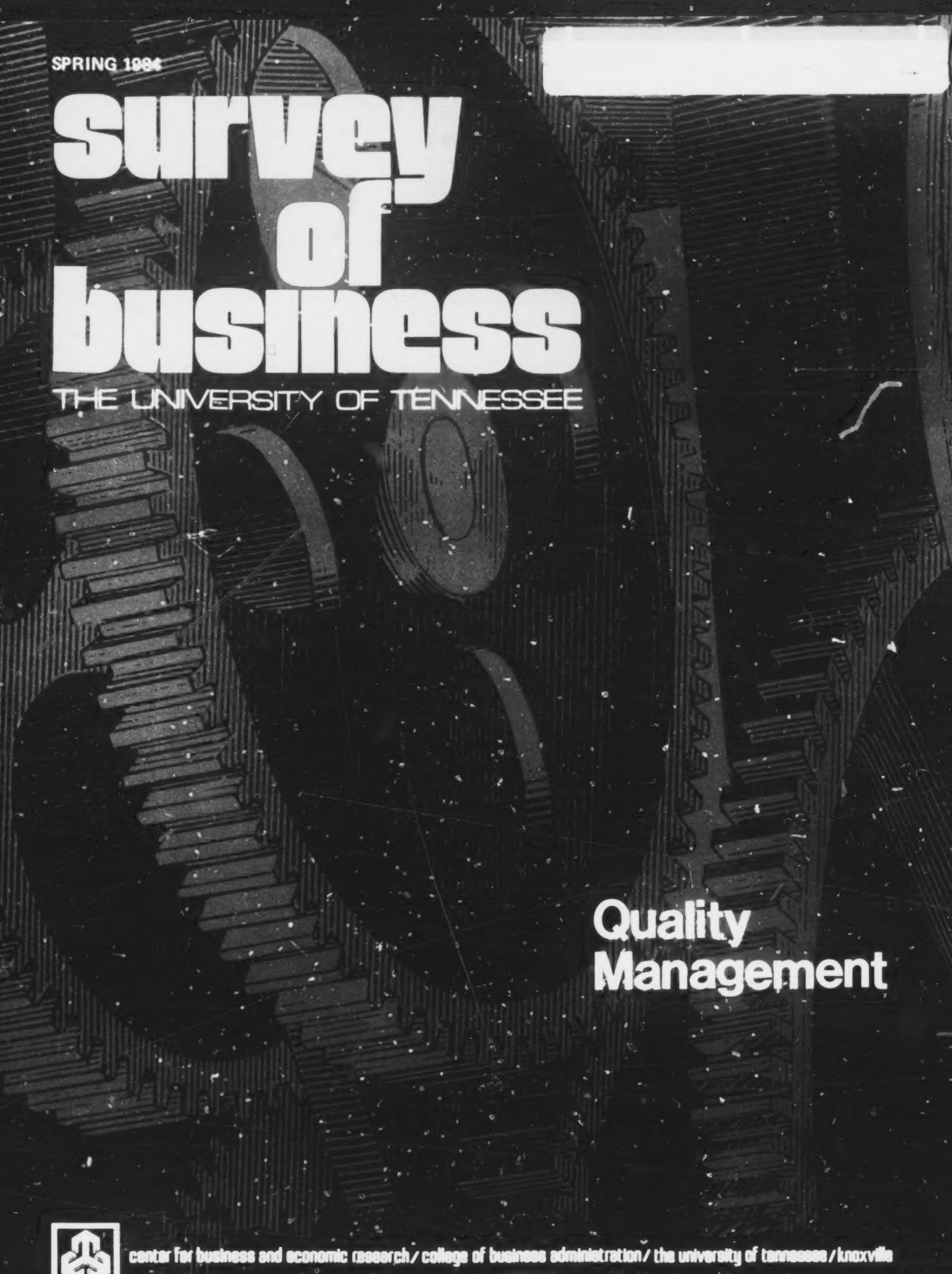

SPRING 1984

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THE UNIVERSITY OF TENNESSEE

Quality Management

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COMMENTS ON QUALITY MANAGEMENT

FROM THE DEAN

The decline of the American manufacturing industry under the onslaught of foreign competition has been widely acknowledged in recent years. Among the explanations offered are the growth of trade union power, the focus of American management on short-run financial goals, and Japanese management mystique. In the process of seeking a culprit, collegiate schools of business have come in for their share of the blame, perhaps deservedly so. It is indeed ironic that the fall of the mighty manufacturing sector should have taken place at the same time that the academic position of the business school was becoming stronger and more secure.

Thus, it is heartening to know that the College of Business Administration at The University of Tennessee has been in the forefront of efforts to restore American preeminence in manufacturing through increasing productivity. Led by Professor Alan Lasater and his statistics department colleagues, and in cooperation with representatives of a cross-section of corporate America, the Institute for Productivity Through Quality and its related top-management and in-house custom programs have rapidly achieved national prominence. It is this success story which is told in this issue of the **Survey**, both in the articles on the underlying concepts and their applications and in the contributions on real-world experience in putting these ideas into practice.

This entire effort epitomizes the constructive interplay of the academic and business communities. Statistical Process Control (SPC), the heart of our executive development offerings in the productivity area, is not a new discipline and involves no startlingly new techniques. Its success in application to the problems of many American businesses today comes about for a number of reasons. First, the time is right; pressure on the "bottom line" assures that. Second, the computer revolution has made possible quick access to information. Third, the technical concepts themselves are not overly elaborate. Finally, the technical concepts alone are recognized as sterile if the broad "human relations" climate in which they are to be applied is not cultivated as a central focus in improving performance.

Many years ago, Frederick M. Taylor, the father of "scientific management" suggested that there was a "right way to manage." Unfortunately, time has proven that there is no *one* right way. We do feel, however, that SPC represents an important focus in one approach to management that is appropriate in many situations and we are pleased to be in the forefront of education in the use of this important tool in undergraduate, graduate, and executive education. I feel confident that readers of this issue of the **Survey**, coordinated by Dr. Sentell, will profit from and enjoy these contributions dealing both with concept and application.

C. Warren Neel, Dean
College of Business Administration

FROM THE CONSULTING EDITOR

For over a decade The University of Tennessee's College of Business Administration has provided quality training and development programs for managers and executives through our Management Development Programs. The Management Development Programs Office continues to respond to the needs of managers and executives as they face the challenges and opportunities presented by a dynamic environment. One challenge facing many American industries today is the competitive threat of their Japanese counterparts, much of whose success has been credited to their management approach, including their widespread dedication to Statistical Process Control. Increasing numbers of American executives and managers are now advocating the use of similar approaches and are examining statistical control and associated managerial systems and requirements.

In response, The University of Tennessee established in the Fall of 1981 the Institute for Productivity Through Quality, a family of development programs which provides intensive, integrated training in management and Statistical Process Control. This issue of the **Survey** is devoted to providing a practical and managerially focused review of SPC and the experience of some of the pioneers in its broad-based applications within well known U.S. organizations.

The first article, by Linda Weaver, editor of **Context**, the UT faculty and staff biweekly newspaper, provides a history and description of the Institute for Productivity Through Quality. Following that, since many readers might not be familiar with Statistical Process Control, two articles written by members of the Department of Statistics, Professors David L. Sylwester and John W. Philpot of The University of Tennessee, describe the techniques and the rationale for the applications of these concepts to not only manufacturing operations, but to support and service activities as well.

"A Change in the Management System," written by William E. Conway (former CEO of Nashua Corporation and current President of Conway Quality, Inc.), addresses the extreme necessity of change in management cultures and organizations as the use of these concepts increases in any business environment. Finally, four case studies of the successful implementation of the tools and concepts inherent in Statistical Process Control are provided by distinguished Institute Alumni – William W. Tennent of the Buick Motor Divisions of General Motors Corp.; Jim Ericksson and Jack Winters of ALCOA's Tennessee Operations; William J. Ownby of McCord Winn, Inc., a subsidiary of Ex-Cello-O Corporation; and V. E. Anderson, of Tennessee Eastman's Chemicals Division. These case studies are indicative of the successes and advances SPC has made in helping American industry cut losses and waste to help put it back in the forefront of industrial competition.

Gerald D. Sentell, Director
Management Development Programs

QUALITY CONTROL: CATALYST IN CHANGING INDUSTRY

LINDA B. WEAVER

When a product develops a bad reputation by failing to perform dependably, consumers don't buy it.

That used to happen repeatedly to one American product after another: quality took a back seat to short-term sales receipts. The business mindset was, "Don't bother to get it right in the first place. Just scrap the lemons; deal with the recalls; and sell, sell, sell."

For a while during the 50s and 60s, the system worked. But as the economy grew worse in the 70s, and consumers squeezed dollars tighter, purchase of U.S. goods fell off and America lost its supremacy in the world marketplace.

The story is old news. But few people realize that while American business was booming, a statistician named W. Edwards Deming was warning that the short-term approach to quality control – defect detection after the fact – was leading down a ruinous road.

Statistical Process Control

In the 50s during the business boom, Deming was pushing common sense: first you analyze a product's defects and track them to the source; then you make a change in operation that might correct the defects and record defects again to see if the problem is relieved or if any other problems are created. Deming did not make the claim that his methods, called Statistical Process Control (SPC), were effortless. They required commitment from all levels of employees – from management to the line worker – to mastery of statistical skills and to creative troubleshooting.

But American business response to Deming was, "When you're on a roll, why be so cautious?" Deming's answer to that question was given when he took his ideas, with great success, to Japan in the 50s.

Japan was suffering from the effects of bad product reputations. Using Deming's methods of prevention of defects "in the first place" helped Japan rise from the butt of "made in Japan" jokes to supremacy in the auto and electronics world marketplace.

In the late 70s, Deming finally began to be heard in the U.S. when American business faced their own bitter equivalent of the Japanese joke. "Made in the U.S." was compared by some frustrated consumers to a surgeon general's warning, "This product may be harmful to your health."

Businesses began looking for causes. Was it the American value system which worships immediate gratification and convenience over durability and performance? Was it the American worker who demanded more and more benefits for less and less work? Was it white collar incompetence – management which never learned to really manage during the business boom?

Fingers pointed accusingly in every direction. Admittedly, blame for the American business predicament can be shouldered by many, but only W. Edwards Deming pointed to a solution which could turn remorse into pride. He was pointing to SPC charts and graphs and giving America a chance to reconsider the cautious approach to quality which did not at the same time sacrifice productivity.

Institute for Productivity

With Deming's blessing, the Management Development Program at The University of Tennessee, Knoxville, was the first organization to supply a mechanism for American business to learn about SPC. Ever since classes began in October, 1981, the Institute for Productivity through Quality has produced over 1000 graduates skilled in SPC.

Developers of the Institute were Dr. Alan Lasater, Dr. Gipsie Ranney, Dr Sophronia Ward, and Dr. Richard Sanders, all UTK statistics professors in the College of Business Administration. Other instructors are Dr. Norman Dittrich, Professor of Accounting; Dr. John Philpot, Professor of Statistics; Dr. Gerald Sentell, Director of Management Development Programs; and Dr. David Sylwester, Head of the Statistics Department.

The effort has been made to keep classes small – to maximize personal learning – despite the capacity demand for the course. Personnel from companies that are household words are regulars. Buick has had an employee in every class – over 200 employees to date. Other companies are ALCOA, Kentucky Fried Chicken, Boeing, Kellogg's, Del Monte, Sherwin Williams, IBM, Memorex, Federal Express, Harley Davidson, and Duracell. Additional prominent companies taking part are Rockwell International, North American Phillips, R. J. Reynolds, Tennessee Eastman, AVCO Aerostructures, Masonite, West Point Pepperill, Cyclops. and Control Data Corporation.

Key to SPC success, according to Deming, is that employees at all levels become educated to the method. So the class rolls at the Institute include executives as well as line supervisors working shoulder to shoulder in the same manner they must work together when they return to their companies.

To learn the method, participants in UTK's Institute for Productivity Through Quality spend three weeks of intensive study – performing mind-stretching exercises with statistics.

Because of the intensity of the program, there is time built in to allow participants to absorb all the new information. Participants come to UTK for a week, go back to work for several weeks, return to campus for a second week, then go back to work and apply what they've learned to actual situations, if possible. Then, they come back to campus for the third and final week of study.

The goal of the Institute is to make statistics comprehensible to everyone. The instructors do not, however, expect participants to jump feet first into a pool of numbers and equations at the risk of drowning. Becky Cummings, a

A Tennessee Eastman employee plots a control chart. The company uses Statistical Process Control as an integral part of its Quality Management Program.

statistical analyst from Pittsburg Plate Glass and a graduate of the Institute, says, "The instructors do a good job of building up slowly."

The first morning is spent learning simply to use a calculator and to read the course workbooks. Then equations and mathematical symbols are explained, one at a time. Problems come next. Participants work them in the workbook and the class reviews them with the instructor. After a problem is mastered, shortcuts are introduced. Each problem builds on the previous problems.

Dr. Gipsie Ranney says that since UTK's Institute is the first of its kind, there are two responsibilities. First is to educate the participants in SPC. But another responsibility is to create a common language for the entire field of statistical quality control, so that SPC will be universally understood in business. For example, precision and accuracy sound alike, but in analyzing a process, they can have very different meanings. After all, the hope is that participants will take their calculators and workbooks back to the line and the boardroom and explain the process to fellow employees and managers. It will help if everyone speaks the same language, Ranney says.

The process of making the charts and graphs speak to participants like paragraphs speak to grammarians is painstaking. The instructor, in the language of equations, writes a formula on the overhead screen – longhand. A personal quality. Laughter ripples through the front row as a luncheon conversation with the instructor is remembered. The human touch.

High Touch

High touch, a coequal with high tech, according to **Megatrends**, is part of the Institute. It's raining? Umbrellas are handy. Thirsty? The coffee pot, tea pot, and soft drinks are ready. Hungry? The Sunsphere, the Sheraton, the Hilton – buffets, banquets, luncheons, breakfasts – are only minutes away. Exercise? The YMCA is reserved

Linda B. Weaver is editor of **Context**, The University of Tennessee, Knoxville faculty and staff biweekly tabloid newspaper, and the 1983 editor of the **College of Business Annual Report**. For three years she served as the UTK Public Relations Office media coordinator for the College of Business Administration.

HEAD BOLT
AVERAGE
NORTH MULTI
NGE

The goal of the Institute is to make statistics comprehensible to everyone. A Buick employee enters data on a range and average chart.

for volleyball. Flu? A physician is called. Tickets for basketball, football, theatre? It's taken care of. Shopping? The van is waiting. Names are imprinted in gold-colored ink on calculator covers, notebooks, and totebags.

Responsible for the precision of arrangements is Tim Carpenter, assistant director of MDP, and Ellen Kendall, program coordinator. They are assisted by Athanese Stacy and Rhonda Wilson, who proudly call themselves "mother hens." All the staff is proficient in CPR.

Brainpower and energy of participants are reserved for the classrooms. Witnessing the statistical learning process is a bit like watching an engine being tuned. The participants are given a problem to solve. Shoulders, like pistons, hunch alternately over workbooks, then calculators. Fingers click, click, click the calculator keys. Eyeglasses fall down on noses. Eyebrows arch, then gather in the middle. Hands hold foreheads. Two heads close in; participants face each other, exchange glances, scribble. They both smile, relax their shoulders. Computations agree. They lean back in the swivel chairs. Deep breaths of accomplishment, mixed with some confusion, spread over the room; a hum, a ping, a rattle, then the whirr of a problem completed and understood – like a quality engine sound. If the ah-ha's were charted, it would look like a normal distribution bell curve.

There are no ties in class, no business suits. The rolled-up-sleeves atmosphere serves the participants well during two morning sessions, two afternoon sessions, and an evening session. Wednesday night is the only night off.

There are some lively exchanges. Wits are as sharp as the Quality brand yellow no. 2 pencils supplied in abundance for the classes. There are arms and hands spread wide, gesturing questions, ready to grasp a massive idea. There are arms folded across chests, looking for all the world like they are hugging ideas so they'll sink in.

There is an occasional yawn. Nobody said it would be easy. There is more coffee, tea, soft drinks to refresh the body, to revive the circuitry of minds pushed to their capacity by new ideas.

"Taking it home is the hard part," says Barry Simmons, who works at the Hickory (North Carolina) Manufacturing Company. They make urethane foam and innerspring mattress parts.

Carrying over the intensity of the classroom to other employees and to management at home is a difficult task. "You really need support from the top down," says Tim Kelly of Nashua Corporation, producers of computers in Nashua, New Hampshire.

Results of Application

Despite the intensity of the institute and difficulty of translating the new ideas to the folks at home, SPC is catching on because it is working. Buick has had employees in every class of the Institute since 1981 – over 200 thus far. One of the problems solved? They were scrapping 432 crankshafts a month. They reduced the number to 18. They were repairing 20,000 pistons a day. That figure has been reduced to 500.

Ford once had a 3.8 percent defect rate for ignition coils. The percentage has decreased to 1.15.

Holley Carburetor had a 50 percent defect rate for a 13-cent valve. Applying SPC, the company reduced the percentage to 1.7.

No one can argue with those figures, which in their own way are as impressive as the sales figures which once deceptively overshadowed the value of statistical quality control.

It is more difficult to imagine the value of SPC to service and administrative functions. But the UTK Institute staff has already planned courses for accounting and shipping inventory control firms, word processing organizations, insurance companies, and hotels and other service industries.

At the introductory dinner for the winter quarter group, Clifford Manning, the assistant superintendent of maintenance for the Buick, Flint, engine division, said that statistical quality control methods are not "magic pixie dust." There is no magic involved in American business becoming competitive once again in the world market. It takes hard work, Manning said, and massive doses of time, patience, and dollars – dollars invested in training in SPC, time devoted to tracking down problems. Buick has invested $375,000 since 1981 in training, which has been made up in reduction of scrap using SPC.

Over 1000 graduates are multiplying their knowledge in their own companies, reducing defects, eliminating scrap. Like seeds, the graduates are sprouting a new breed of quality in the American workplace.

That's something for consumers to think about every time an engine purrs. ■

MONITORING ADMINISTRATIVE AND SERVICE FUNCTIONS USING STATISTICAL PROCESS CONTROL

JOHN W. PHILPOT

If one were to tour the manufacturing facilities of the Fortune 500 companies, it would be obvious that quality has become the byword, and statistical process control (SPC) is the tool being used to make sure that quality is being built into production. Companies like General Motors, IBM, Hewlett-Packard, ALCOA, and the Harris Corporation have embraced the philosophy of Dr. W. Edwards Deming and are instituting SPC programs to monitor the ongoing quality of their manufactured goods.

These same companies devote a large portion of their budgets to non-manufacturing concerns (e.g., marketing, transportation, and inventory control). Other large companies are entirely service oriented (e.g., insurance). As John Naisbitt's book, **Megatrends**, points out, we are becoming a service-oriented society. Yet service applications of SPC are so rare as to be anomalies. Companies that use SPC to monitor their fabricating plants from start to finish are keeping tabs on their administrative services with methods developed in an earlier century.

Why? Does SPC apply only to manufacturing? Deming would say no. In his famous "eight paragraphs," he outlined his philosophy and clearly meant it to apply both to products and services (Stockbridge, 1982). Deming (edited to focus on service applications) says:

1. The objective of an organization must be preservation for itself and for the people who depend on it.
2. The only way to achieve self-preservation is by providing services to the customer which are pre-eminently desirable in terms of professionalism, appropriateness, pleasantness, completeness, convenience, responsiveness, timeliness, and accessibility, known collectively as quality.
3. The other element of desirability – low cost, will follow naturally from the others and need not be sought as an end in itself.
4. Desirability, or quality, is a somewhat comparative or subjective judgement, and will be seen to be adequate only as long as it is constantly and significantly improved.
5. Constant and significant improvement of products and services over long periods can be achieved only by disciplined and rational effort, including a continuing sequence of ". . . measure, analyze, adjust . . . ."
6. Chief among the ways of achieving such control are various methods of statistical analysis. These in themselves do not improve anything. Rather, they indicate quickly and inexpensively which parts of the process are likely to respond to attempts at improvement.
7. Actual improvement based on analysis requires diligence, industry, skill, and imagination, as well as knowledge of and experience with the activities involved.
8. An absolute requirement for such rational conduct is an organization in which most of the people most of the time will be confident, flexible, skilled, cooperative and cheerful. All of the things which contribute to fear, ignorance, inflexibility, short-sightedness and meanness must be rooted out.

This is not an easy program to institute. Deming is not only suggesting SPC as the tool of choice for establishing control; he is coupling that control with a humane approach to the use of information. Only in an atmosphere that is free from fear will employees help in the effort to make the program a success.

But the question remains: why so few administrative/service applications of SPC? Perhaps it is a self-perpetuating situation – there aren't many uses because there aren't enough examples to follow, and there aren't many examples because so few applications have been tried. It is time to break that cycle.

Control Charts

Below are three simple examples of the use of control charts. They illustrate the three main types of SPC charts applied to three administrative/service areas that should be common to a broad range of companies. The potential problem areas and the charts used to identify them are:

- Controlling delivery schedules using the average ($\bar{x}$) and range (R) chart.
- Monitoring regional supervisors using the proportion of success (p) chart.
- Tracking the number of lost-time accidents using the number of occurrences in a unit time (c) chart.

In all cases the idea of the control chart is that imperfect processes have variability, but that when the variability shows a consistent pattern, the process is said to be in control and all the measurements help define a center-line or overall average. The consistent pattern of variability means that practically all of the measurements should fall within three "standard deviations" of the center line. When points fall beyond the three standard deviation limit, it suggests that the process is out of control, at least at that point, and an investigation as to why this occurred should turn up some special cause of the out-of-control condition.

Delivery Schedules

Many firms are faced with situations that require deliveries in adherence

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to a prearranged schedule. Consider catering via vending machines. Prompt attention is required in order to insure freshness of the product and to replenish exhausted supplies. Inattention may result not only in lost revenues but customer dissatisfaction and loss of sites.

Not all vending machines need to be serviced with the same frequency. Most are governed by the need to replenish the supply and demand varies from site to site. A few low-demand sites are governed by the need to freshen the supply; however, all have target dates for optimal resupply, and the objective is to monitor the system of resupply by the field service representatives (FSRs). The basic measurement is the difference between the target date and the delivery date. The data illustrating this interaction are found in Table 1. The data come from the logs of 20 FSRs and were spot-checked at random via telephone inquiries and supervisor follow-ups to insure continuing accuracy. Five randomly chosen sites were tabulated for each FSR.

TABLE 1

DEVIATIONS FROM THE TARGETED DELIVERY DATES FOR VENDING MACHINES

Field Service Representative	Sample Vending Machines						
	X1	X2	X3	X4	X5	$\overline{X}$	Range (largest to smallest)
1	2	0	1	2	0	1.0	2
2	1	-1	2	-1	0	0.2	3
3	-2	3	-1	2	-3	-0.2	6
4	1	2	-2	-4	-3	-1.2	6
5	-1	0	-1	-4	1	-1.0	5
6	2	2	3	0	0	1.4	3
7	-4	-5	-6	0	-4	-3.8	6
8	3	0	0	2	-5	0.0	8
9	2	0	2	2	-2	0.8	4
10	-3	1	2	-5	-3	-1.6	7
11	4	3	-1	-1	-1	0.8	5
12	-3	3	1	1	0	0.4	6
13	-2	1	0	0	-1	-0.4	3
14	0	-2	0	-3	3	-0.4	6
15	2	-2	-1	0	0	-0.2	4
16	-5	-3	-2	4	-4	-2.0	9
17	-2	-3	3	2	-3	-0.6	6
18	3	-2	0	-5	1	-0.6	8
19	1	-5	1	0	-1	-0.8	6
20	2	-1	-3	1	-2	-0.6	5

Note. In the responses, zero represents on-time delivery; negative numbers represent late delivery; and positive numbers represent early delivery. X = target date minus delivery date; $\overline{X}$ = average.

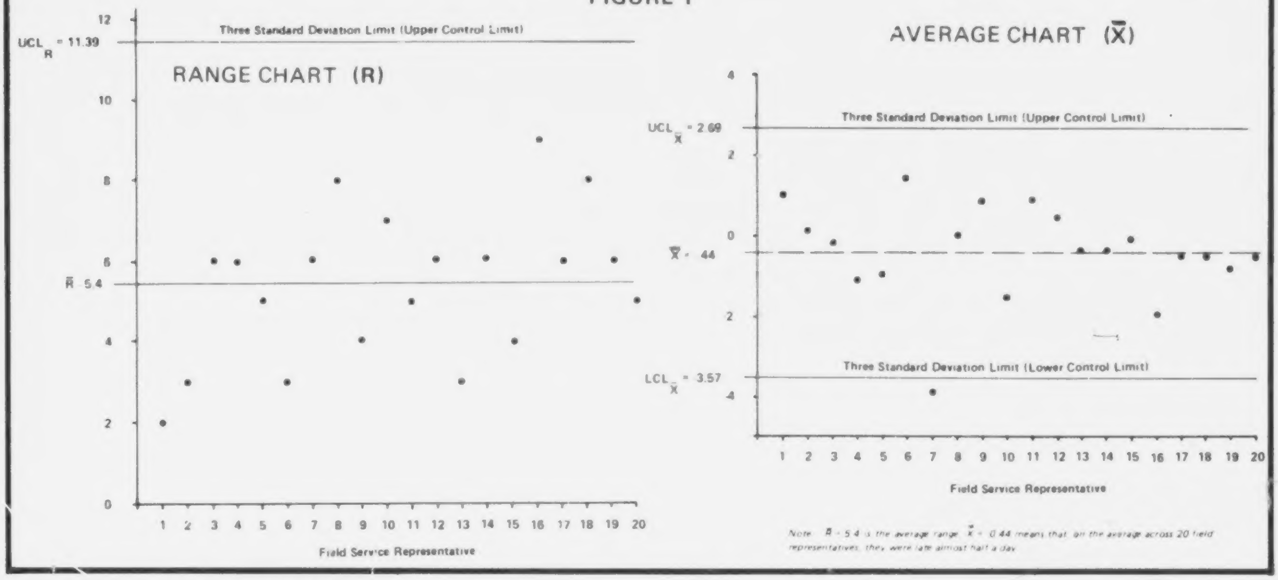
The plot of the ranges, in Figure 1, shows that the variability across five sites is about the same for each FSR. This justifies examining the $\bar{x}$ chart in Figure 1, where it can be seen that most deliveries are being made reasonably close to the target dates, but that FSR#7 is having trouble adhering to the standards. The supervisor's job now is not to fire FSR#7. That would be counter-productive. Instead, it is essential that the supervisor help FSR#7 find the root of the problem and provide whatever assistance may be necessary to correct it. It is important that the atmosphere be one of cooperation rather than confrontation. Otherwise, personnel will tend to hide negative information rather than provide facts in an objective manner. Keep in mind that the charts work only with accurate, honest data.

Effectiveness of Regional Supervisors

The second example parallels the situation of many firms that market their services across large geographic areas, perhaps even nationwide. Regional supervisors are given a domain of responsibility and a number of subordinates whose responsibility it is to provide the service. Consider a relatively new mode of advertising using wall media where display ads in pubs and bars are to be changed monthly, according to contractual obligations. Past experience has shown that 97 percent of the time, on the average, it is possible to change the ads on schedule prior to the beginning of a new advertising cycle time. That is, when the process is in control, the long-term average for the percentage of correct postings is at the 97 percent level.

The implications of this are enormous. First, this knowledge gives the company the basis for monitoring the effectiveness of its regional supervisors. It is not necessary for the company to demand a 97 percent success rate from each supervisor at all times. Regional performance can vary, up or down, but within limits. Those limits are plus or minus three "standard deviations"

FIGURE 1



Note: $\bar{R}$ = 5.4 is the average range. $\bar{\bar{X}}$ = 0.44 means that, on the average across 20 field representatives, they were late almost half a day.

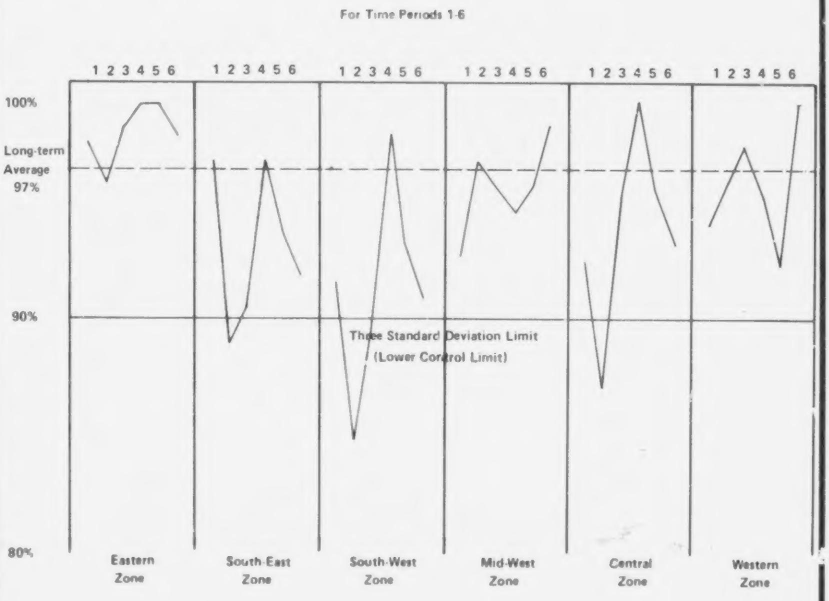
around the long-term average. For example, based on samples of 53 sites in each region, the rates for supervisors can vary between 90 percent and 100 percent without the necessity of company intervention. The company needs to take corrective action only when a given region shows a success rate of less than 90 percent.

Second, with a long-term average of 97 percent success and the above monitoring system, the company is in a position to offer its customers a guaranteed success rate. For example, any customer willing to check the ad change process by sampling at 600 sites or more can be guaranteed to find at least 95 percent of the sites displaying the correct ad. This guaranteed level is nothing more than the 97 percent minus three "large-sample standard deviations." The fact that the 95 percent contract level is higher than the 90 percent required of supervisors is a reflection of the fact that large samples vary less than small samples; but both samples of 600 and samples of 53 are varying around the 97 percent average.

To illustrate the process, some data for problem periods were chosen. Figure 2 shows the percent of correct ads by zone (i.e., by supervisor) for six different time periods. Those supervisors with out-of-control points are quickly spotted. Investigation revealed

FIGURE 2

PERCENT CORRECT POSTINGS



special causes (unusually severe snowstorm; high employee turnover) that could be circumvented by better preparation or planning. The results for the six zones can be pooled to give an indication of how the overall program is going. Displayed in Figure 3 are the national averages for correct postings in the six time periods, showing that the guaranteed rate of 95 percent correct postings is close to being met, even with the problems that were encountered.

Tracking the Number of Lost Time Accidents

The need to control lost-time accidents is apparent to any employer who has been deprived of a key employee without warning, or been involved in a lawsuit over the safety of working conditions. This example makes use of the so-called c chart, which is a plot of frequency counts of events that occur in a given unit of time. The c chart is seen in Figure 4, where the number of lost-time accidents is plotted as a function of a sequence of time segments, each segment representing 10,000 worker hours. The figure 10,000 was chosen because it represents the average number of hours worked per month at a moderate sized plant involving over 50 people. Each unit represents roughly a month of working time. The process is clearly in control over the first 27 units of time, but at time periods 28 and 29 it goes out of control. Review of records revealed that the increase in the number of accidents coincided with large rush orders at the plant. Further study demonstrated that the economic tradeoffs of the rush orders were marginal in the long run, especially if the risk of a costly accident was increased. Procedures were instituted to reduce the possibility of two types of accidents, and monitoring was continued using new bounds computed from just the in-control data.

Other Benefits

It has been said that "the development of statistical controls in all fields of management holds the greatest promise for fundamental gains in managerial control" (Bicking, 1950). What held promise in the 50s may well become a necessity in the 80s. The reasons are straightforward:

- The information explosion is here. Many companies are getting computer-generated reports that are so bulky they cannot be digested by a harried staff. Control charts offer an effective way of synthesizing the important information so that it can be understood.
- Because the control chart is a pictorial display of information, everyone concerned can have the same level of understanding of the situation, be it good or bad.
- The SPC charts make it clear when corrective action is necessary, and even more importantly, when no action is appropriate.
- Our competitors are beginning to apply SPC to administrative service areas.

Japanese manufacturers are now in the forefront of managerial applications. Can the U.S. afford to be far behind? ■

Bicking, Charles A., "The Application of Quality Control to Administrative Problems," Industrial Quality Control, May 1950, pp. 21-25.

Stockbridge, Michael, Personal communication, 1982 (based on Deming lectures and conversations).

Naisbitt, John, **Megatrends: Ten New Directions Transforming Our Lives**, New York: Warner Books, 1982.

FIGURE 3

PERCENT CORRECT POSTINGS NATIONWIDE

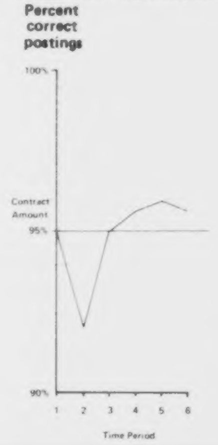
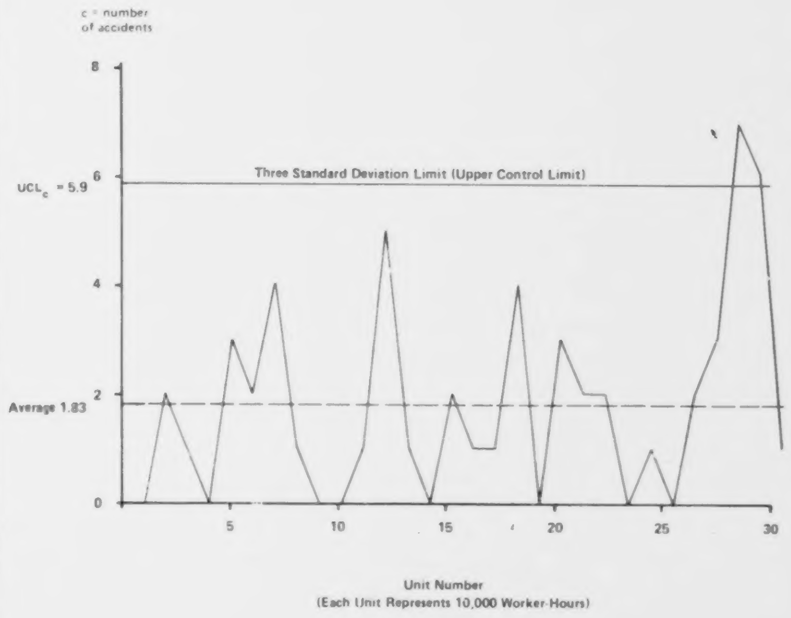


FIGURE 4

C CHART



STATISTICAL TECHNIQUES TO IMPROVE QUALITY AND PRODUCTION IN NON-MANUFACTURING OPERATIONS

DAVID L. SYLWESTER

As consumers, we have all heard about Japan's successes in designing, building, and marketing products of high quality at competitive prices. One of the keys to Japanese success is the use of statistical techniques as tools that enable management and employees, *working together*, to identify and solve problems. Those successes stem from the efforts of an American statistician, Dr. W. Edwards Deming, who initiated the use of statistical process control techniques in Japan after WWII by applying statistical techniques to improve productivity and quality not only in the traditional manufacturing setting, but also in such diverse areas as hospitals, legal firms, railway and truck transportation systems, government agencies, and research organizations.[1]

The purpose of this article is to illustrate the basic concepts and some straightforward steps that can be taken by any organization which can lead to increased productivity and quality. We shall concentrate on organizations whose primary product is a service such as delivering packages, filling orders, maintaining inventories, and offering banking and insurance services. The key to success is working smarter instead of harder. A corollary is that the organization should be run so that policies and practices encourage *all* the employees to participate in working smarter.

There are three major components to be examined:

1. The service should be designed so that it is appropriate for its intended purpose.
2. The work to be accomplished should be done right the first time.
3. Monitoring procedures should be used to facilitate early detection and correction of problems.

Although there are seldom easy solutions to problems, especially if the problems are well ingrained in an organization, careful and systematic attention to the three components above can bring steady, *documented* progress to any organization which is committed to improving quality. It is perhaps surprising to discover that programs developed and implemented to improve quality will also improve productivity, the simple reason being that doing it right the first time is vastly more economical than fixing it later or making excuses for unsatisfactory services.

The Right Service at the Right Price

Every so often, it becomes obvious that a new product opportunity has arisen. Who would have foreseen 40 years ago that sit-down restaurants with extensive menu choices would take second place to "fast-food" chains with limited menus and drive-up windows? In 1971 the concept of a "hub and spoke" configuration for reliable overnight package delivery throughout the U.S. at a competitive price was an untested idea in the mind of a university student. But in 1983, the Federal Express Company passed the billion dollar mark in gross receipts, setting a new record for rate of growth (without acquisitions) among companies in the Fortune 500. At Federal Express all components must work together and on schedule if every one of a third of a million packages is to find its way from any U.S. sender to any U.S. recipient in a short 20-hour period. Success under such a demanding time table is based on the concept that the entire process is a "system" in which every component must do its part, because one weak link can cause disaster. Federal Express has designed a system that is capable of doing the work required and manages the system so that the work is accomplished according to design: each package is delivered to the right place at the right time at a competitive price.

In your own arena of operations, how do you know what is the right service and the right price? Do you ask this question of all your customers, or do you listen only to those who have complaints? Do you regularly invest thought and energy into anticipating future opportunities with new services and/or new customers? Or do you simply concentrate on doing the best job today? (This would be a short-sighted strategy if you manufactured buggy whips in 1907.)

The Key Questions

1. Who are my customers? or What is my desired customer market?

The "customers" of retail sales operations clearly are those persons who purchase goods. For a wholesale operation the customers are retailers for goods, restaurants for food, etc. The purchasing department of a company has as its customers not only departments which request specific goods, but also the accounting office which pays for the purchases. Who are the customers for the accounts receivable department of a company? If you don't know or forget who your customers are, you may easily fail to be responsive to their needs.

2. What do my customers want? or What are the necessary characteristics of a quality service?

It is easy to accept from a marketing expert an opinion of customer needs. But the expert may tend to describe the needs of only a selected segment of your customers – perhaps the most vocal ones. Customer needs clearly will have a large impact on the services that you provide; therefore you must pay attention to them. The bank customer who is looking for convenience in routine transactions may very well prefer automatic computer-run tellers which are more widely available than human tellers with

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limited locales and very limited hours. In the same vein, a wholesaler who fills orders quickly and fully may have a distinct advantage over competitors if the customers (i.e., retailers) value minimum inventories which save space and money.

While asking your customers what they want is a necessary step (ideally through carefully conceived and executed studies), don't hesitate to use your own experience and special knowledge to devise new and improved services (even when a need is not yet perceived, perhaps). For example, changes in government regulations now make it possible for retail establishments to offer a wider variety of financial services. You may gain a better understanding of potential opportunities by dividing your customers in terms of subgroups of similar types (such as commercial versus home telephone customers).

3. What are the design requirements for my operation?

As we shall illustrate later, one benefit of statistical charts is to document for both management and employees where the group stands with respect to quality. Necessary to this goal is the concept of design specification by which quality is measured in quantitative terms. Targets or goals to be met are then also given in quantitative terms. We are each acquainted with marketplace claims which reflect such standards. For example, one can purchase an automobile battery with a guarantee of 24, 36, or 48 months. Presumably, the engineers have designed the product so that the batteries have (on the average) those specified lifetimes. While toothpaste ads may tell us about the whiteness of our teeth after using their product, they also describe quality in quantitative terms such as "this product promotes 20% fewer cavities". Commercial and home goods movers publish the percentage of jobs in which they delivered on time, since for many prospective customers that is one of the relevant quality characteristics of their moving service.

> ***While asking your customers what they want is a necessary step, . . . don't hesitate to use your own experience and special knowledge to devise new and improved services . . . .***

Specific Standards of Operation

Many operations can have quality-related standards specified in quantitative terms which can be used to set targets or benchmarks for performance. Following are some examples to generate ideas on how a company might start to specify standards in its operational arena – and how adherence to these standards might pay off.

1. Modern banking depends on the accurate reading of magnetic encoded information on checks. Reading errors of 0 percent are not practically feasible because of variation in paper, magnetic ink, reading machines, and occurrence of mutilated checks. But at 20¢ per check for rehandling, a reading error rate of 7.5 percent cost one New York bank about $450,000 per year. That bank now pays close attention to the quality of checks purchased. They require vendors to manufacture checks that will cause reading errors of less than 2 percent. The bank saves about $325,000 annually from reduced handling costs. Furthermore, it is appropriate to require each vendor to document, through appropriate statistical sampling and testing, that the bank's standards are being met. Vendors that can show documented evidence of consistently meeting or exceeding the bank's standards will be in a much stronger competitive position for future orders.
2. Insurance companies are required to meet regulatory agency performance standards in terms of response time to claims submitted. Standards may be stated in terms such as "95 percent of claims must be responded to within ten days". One company which had audit records to document that they met or exceeded such requirements was successful in winning a very large, long-term contract to handle the insurance affairs of a large retirement group. The new customer chose the company partially on the basis of quality standards reflecting fast response time.
3. The purchasing department of one manufacturing company kept inventory records to manage day-to-day ordering of materials. At the same time, the head office required an accurate annual inventory for tax purposes. But no inventory of thousands of parts will be 100 percent accurate – nor does it need to be, for practical purposes. The company reached agreement on accuracy requirements (in terms of dollars of inventory) for tax purposes. At one of its three plants, the purchasing department confirmed via a special audit that their on-going inventory system, with accuracy kept on-target through statistical charting techniques, could furnish the data needed for tax purposes. The annual inventory was dropped at that plant. The other two plants which did not meet targeted accuracy levels are being assisted in their efforts to attain the necessary standards.
4. Many companies lose a substantial amount of money from delays and errors in billing. Some components of such problems are the time from delivery of goods until the bill is prepared and delivered, accuracy of the information on the bill (e.g., amount, account number, mailing address), time intervals before unpaid bills are followed up, and processing time of a check sent in

payment. For large bills, it may be financially beneficial to spend extra effort to reduce delays in the process of collecting the amount due.

One company tracked the path of paperwork for a sample of bills and discovered very quickly how "small" errors in recording policy numbers cause *extensive* delays later in processing received checks. They also discovered that the processing path of checks received included one unnecessary stop. This stop not only represented unneeded (and hence unproductive) work, but also thousands of dollars of lost interest revenue from delayed deposits. Once a careful and complete diagram of the process was made, it was easy to identify and implement changes to save a great deal of money – and all this without the purchase of any new equipment. Working smarter really worked.

In summary, the first component to improve quality and increase productivity is a careful study of what the operation or service *should be* and quantitative measures of what the current state-of-affairs *really is*. Opportunities for improvements will quickly become apparent.

Doing it Right the First Time

What can be done to produce services that meet design requirements? One may initially believe that poor or variable quality in manufacturing can be corrected by careful final inspection. As an operating practice, "inspecting quality into the final product" is costly enough to quickly put the manufacturer at a great competitive disadvantage. In non-manufacturing operations it is equally costly to get things right only by doing them twice (or more). Besides the immediate dollar costs, as in the banking example above, there are long-term costs. We each have had our own frustrating experience of letter writing to correct a billing error. In the end the seller may finally have gotten the amount right – but he may also have lost us as a customer. In many cases, such as in food service, correcting an initial mistake may be difficult, if not impossible. The restaurant's reputation or the customer's satisfaction is permanently lowered.

How then can a company, or a department within a company, arrange matters to have a good chance of doing it right the first time – and at a competitive level of effort and price? First of all, there are no one-day miracles. Success is attainable only when management and staff are committed to *working together* to take the many small steps needed to produce quality services on a continuing basis. Employees will participate if they can clearly see that management cares about quality and will carry out its responsibilities in achieving and maintaining quality. Above all, a climate of fear, a search for a scapegoat to blame, or dependence on slogans instead of action will absolutely sabotage the best intentions.

1. Employees can help identify problems. Listen to them!

Before a company asks for an outside expert to define and solve its problems, it would be worthwhile to ask its own inside "experts", the people who experience the hundreds of day-to-day problems that result in variable or low quality operation. Not only will the company obtain useful information at little or no cost, but the employee whose suggestions are taken seriously by management is immediately motivated to work smarter and to generate additional ideas.

To keep your equipment running smoothly, do you give your employees encouragement and time to keep it clean? Do you also respond to chronic complaints about poorly operating equipment by requiring the manufacturer or the service company to fix it – and fix it so it stays fixed? Although forms to be filled out may have originally been initiated for good reasons, are those reasons still appropriate for your present needs? If your employees do not know why certain forms must be filled out, it may very well be that those forms have lost their relevance. Moreover, work perceived as busywork will be done poorly and without a sense of satisfaction by the employees.

2. Employees want to do a good job. Help them.

No person is happy performing below acceptable standards. But if low performance means dismissal, you can be sure that the fearful employee (and friends) will go to great lengths to hide the problem rather than ask for assistance in solving it.

One company introduced a training program to improve keyboard operations. While some of the operators were initially suspicious of the possibility of new demands in performance, they quickly learned that the training, which included correct posture and proper finger movement, made their work easier. The increased productivity paid for the costs of the training program in only six weeks. The company estimates a savings of $1 million per year in data entry costs. Improved lighting, ventilation, and seating comfort brought further gains in productivity as well as in employee satisfaction, greatly reducing the costs due to operator turnover. Developing an atmosphere of understanding, trust, and support also smooths the way for future changes.

If employees know that management wants to help them to do the best job possible, then the employees can be

> ***. . . The first component to improve quality and increase productivity is a careful study of what the operation or service should be and quantitative measures of what the current state-of-affairs really is.***

given the responsibility of doing the simple statistical charting to monitor quality levels for their own work. If problems occur, the worker can address them immediately. Management will have a better chance of determining the real cause than would a distant quality assurance department or inspection station. One modest-sized manufacturing plant was able to abolish 51 positions in their quality assurance department after the introduction of statistical process control, with the machine operators keeping their own charts. Getting rid of outside inspectors not only saves money, but it gives each worker an increased sense of self worth and the motivation to do it right the first time.

> ***Systems problems may often be recognized by individual workers, but their solution requires changes in policies, practices, or equipment — and these are under the control of management.***

3. Most problems are system problems. They are the responsibility of management and must be solved by management.

We all expect clean glasses at a restaurant. How can the manager ensure this at a competitive cost? Listening to customer complaints may tell you that there is a problem – but it won't tell you what needs changing. Blaming the young glass washer may make you feel like an action-oriented manager, but it usually will not solve your problem. Even worse, such threatening behavior may shut off the best source of information regarding the real reason(s) for complaints.

A straightforward design requirement is to specify that only a very small percent of glasses may have smudges (to require 0 percent with smudges is unrealistic and in the long run not attainable at a competitive cost). Of the variety of methods that could be used to determine if the design specification is being met, a cost-effective approach is to use simple statistical charting methods based on thorough checks of samples of trays of glasses. One must determine the percent of glasses on each tray which do not meet the cleanliness standard. Using a *sample* of trays (instead of checking *all* glasses) results in more careful and thorough inspection, while furnishing sufficient information for the monitoring operation.

> ***. . . The company level goal is to produce a quality product on time at a competitive cost.***

The charts of the inspection process are useful to management when there are problems to be solved. If individual workers differ in quality of glass cleaning, this will be apparent from the charts. The remedy may be to offer appropriate (additional) training for certain employees. But if the quality is observed to be low for all employees cleaning glasses, then the problem may very well be a system problem which might require modifications in the cleaning machinery (including consideration of the water quality and detergent used).

Systems problems may often be recognized by individual workers, but their solution requires changes in policies, practices, or equipment – and these are under the control of management. An excellent example of system problems appears in operations which are paper-intensive. Errors made at an earlier stage are often first detected and require correction at a later stage. Is this the most effective course of action for this problem? Does the operating practice encourage each employee to do his or her own part correctly? Why should a busy employee spend time to correct another person's errors? Indeed, the manager may instruct the worker not to waste time correcting the errors of a department run by another manager who may be also competing for promotion.

The on-going audit system for one company tracks for each department the percent of internal errors (errors generated within that department) and the percent of external errors (errors that were made in previous departments that filled out the forms sent to the present department). Such information obviously has immediate value in helping a department manager determine where the problem might be, but it takes higher level management to implement a policy that requires each department to be responsible for doing its work right the first time. Forms with errors generated in Department A, but first detected in Department B (or even C or D), should be returned to Department A to be corrected.

Some system problems are much more difficult to detect and solve. A successful remedy may require the cooperative efforts among a number of separate departments. For example, the purchasing department is told by accounting to cut costs, by the engineering office to purchase materials that meet design specifications, and by manufacturing to deliver the materials on time. Whenever compromises are made among the competing requirements, it is possible that one department "wins" and the others "lose". But the company level goal is to produce a quality product on time at a competitive cost. Thus, a wise accounting department manager may recommend an *increase* in purchase costs, because careful study has shown that the lower quality alternative eventually leads to much higher manufacturing costs due to increased scrap. Similarly, the factory manager should be praised for *increasing* production costs by adding quality inspectors early in the manufacturing process, if this change improves quality enough to lower subsequent warranty costs. In shifting costs from one operation to another, the usual company accounting practices may present a misleading picture regarding benefits obtained. Thus, accounting practices must also be reflective of the system nature of the operation.

Statistical Techniques to Guide and Monitor Your Operations

In the preceding sections we have illustrated two basic components of a coherent program directed toward improving quality and productivity. The first component is to develop a clear idea of the task to be done, along with definitions of quality specified in quantitative terms. These definitions allow you to set quality standards or targets to be met. The second component is to have practices and policies which develop employee participation in contributing to solving problems and maintaining quality standards.

The third component is the use of statistical techniques in helping to identify problems, give guidance in seeking solutions, monitor on-going operations and, most importantly, show in clear quantitative terms the steady march toward improved quality and increased productivity.

The basic aspects of the statistical procedures are very straightforward and can be used by persons with only a modicum of high school mathematics. Their value comes not from any technical sophistication, but rather from the use of statistics *in conjunction* with the first two components discussed above. The goal is to bring the *entire system* under control. The unmistakable improvement in quality that is seen via statistical process control charts is a strong motivational force to make the team proud of their accomplishments and to justify further support from management.

We can only briefly describe the basic techniques here. More complete examples with technical details can be found in the Philpot article in this issue and in textbooks.[2]

1. Pareto Analysis

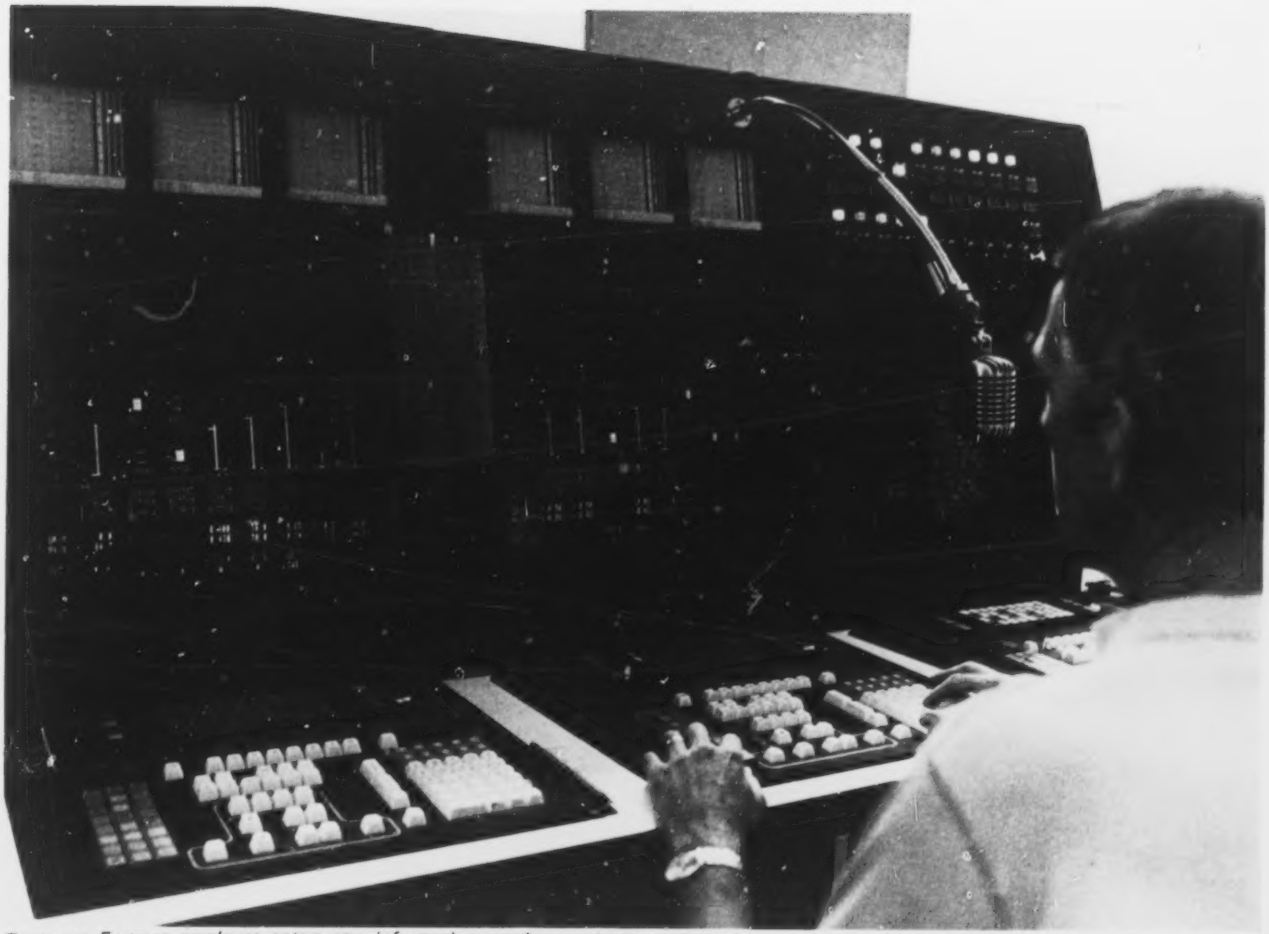
In a given operation there will usually be several types of errors. A Pareto Chart simply shows the relative frequency of each type. For example, an audit of filled out order forms may show a total of 100 errors, of which 42 are incorrect mailing addresses, 30 are incorrect billing information, 15 are incorrect catalogue numbers for ordered items, and 13 are illegible entries. This distribution of errors directs you to incorrect mailing addresses as the leading problem that should be attacked first. As an extension of the above Pareto analysis, one may be able to assign an approximate unit cost for each type of error. One can then find the estimated total cost (frequency of occurrence times the unit cost) for each type of error. An infrequent error with a high unit cost may have the highest total cost and should therefore be investigated first.

2. Chart for Percent of Errors (p-chart)

If a sample of, say, 50 items is taken periodically and audited and the percent of items in each sample that fail to meet a specified standard are plotted on graphs, one obtains a picture over time of the quality level. For example, one could plot the percent of dirty glasses from trays of 50 glasses. The average of the plotted values represents a measure of the actual long-term quality performance and should be compared against a targeted quality level. Even if the process behaves in a consistent manner, the plotted points will exhibit variation because some variation is natural in every system and also because the calculated percents are based on a *sample* of data. There are formulae to set allowable statistical limits (called control limits) for such random fluctuations. Points falling *outside* of these limits are indicative of a change in the process and call for investigation by the worker responsible for that job (with technical assistance as requested). (There are no changes in the basic ideas if one plots instead the percent of items that *meet* the specified standards.)

3. Charts for Number of Errors Per Item (p-chart)

The p-chart described above is used when each item either fails or else meets a stated specification. In some processes, such as filling out an order form or keying in a column of information, it is appropriate to *count* the number of errors on each form audited. If one periodically selects a small sample (five forms) and plots the total number of errors per sample, one obtains a picture over time of the average number of errors per five forms. As for p-charts, there are statistical formulae for calculating control limits which depict the range of usual variation for the values observed when the process behaves in a consistent manner. Points above the upper control limit are indicative of an increase in the average rate of errors and should be investigated to determine a cause and corrective action taken. Points below the lower control limit imply a decrease in the average error rate and suggest that there may be an opportunity for future improvement, if



Tennessee Eastman employee enters new information on the terminal in order to have access to production data throughout the manufacturing process.

a reason for the observed decrease can be determined. The plotted values can also be compared against standards or target values to ascertain whether the system is operating according to specifications. (The standards may be ones imposed by an outside regulatory agency.)

4. Charts for Continuous Variables ($\bar{X}$ and R charts)

In some cases, quality can be specified in terms of a variable which is continuous in contrast to the count data used in p-charts and c-charts. For example, it might be desirable to study the length of time before payment is received on bills mailed out. For continuous variables, it is useful to keep track of two characteristics: the average value (such as average payment waiting time) and the variability of the waiting times. Variability measures whether all payments are received with about the same waiting time (small variability), or whether there are some payments with irregular payment times (large variability).

To describe the process statistically, the payment waiting times for samples of, say, five bills are observed. *For each sample* the average waiting time, $\bar{X}$, is plotted on one chart and the range, R = (largest value) – (smallest value), is plotted on the second chart. As for p-charts and c-charts, statistical control limits are calculated for each of the two charts. If the process is consistent (i.e., in control), the plotted values will fluctuate within the control limits. Points outside the control limits indicate deviations from the expected fluctuations and call for interpretation and possible action. For example, a sample with a much larger $\bar{X}$, but a typical value of R, indicates that for the *majority* of payers, waiting times have shifted upward. On the other hand, a sample with a typical value of $\bar{X}$, but a larger range of R, suggests that there may be a (small) *subgroup of payers* with waiting times quite different from the majority of payers. The subgroup could represent accelerated payments or delayed payments, depending on finer details to be investigated. Charts for $\bar{X}$ and R can be used not only to ascertain if the payment process is changing over time, but also to help predict the cash flow from payments in the near future.

5. Histograms

A histogram for a sample of payment times is simply a plot of the percent of payments that were received within the first week, the percent received during the second week, the percent received during the third week, etc. Histograms are valuable for refined investigations of the characteristics of a system such as uncovering the presence of subgroups with special patterns (e.g., slow payment habits), or in estimating whether the process is capable of meeting design specifications (e.g., can 95 percent of all insurance claims be responded to within the time period specified by the regulatory agency?)

Conclusions

Furnishing services to your customers that are suitable for their needs, competitively priced, and consistent in quality is a goal that is attainable and that will pay great dividends. There are no easy paths to attain such standards; rather, it requires a commitment by management to organize and manage the work so that the separate components work together as a coherent system.

We have discussed three components that are an integral part of a long-term program to improve and maintain quality and productivity. Management must determine the appropriate design characteristics of each service and define quantitative measures for quality assessment. Management and employees must work cooperatively to accomplish the work and solve problems which arise. The majority of problems are system problems which may be identified by motivated employees, but must be solved by a committed management. Statistical techniques can help in the program of maintaining and improving quality by directing attention to problems, monitoring on-going processes to help keep them on target, and documenting the slow but steady improvement in quality. ■

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1. Deming, W. Edwards, *Quality, Productivity, and Competitive Position*. M.I.T. Center for Advanced Engineering Study, Cambridge, MA 02139 (1982).
2. Philpot, John, "Monitoring Administrative and Service Functions Using Statistical Process Control: Some Issues and Examples," this issue, page 7; Grant, Eugene L., and Leavenworth, Richard S., *Statistical Quality Control*, Fifth edition. (New York: McGraw Hill Book Company, 1980).

A CHANGE IN THE MANAGEMENT SYSTEM

WILLIAM E. CONWAY

This article describes a revolution in the operating management system whose purpose is to make dramatic improvements in the quality and reductions in cost of products and services for consumers. While working in industry, my managers and I developed the system from our own experience in business and from the philosophy of W. Edwards Deming.

When these techniques were applied at the Nashua Corporation, there were vast improvements in both the level of productivity and the quality of products and services as well as a reduction in costs.

Components of Change

There are four principal components: (1) imagineering, (2) the human relations program, (3) broad use of statistical methods, and (4) broad use of industrial engineering techniques.

Imagineering is the process of visualizing how things would be if everything worked right all the time, if everyone cooperated fully, and if all the latest equipment and technology were in use. This part of the process has the following three functions: (1) to make people aware of the potential for improvement, (2) to suggest areas in which to look for improvement and advise where to collect data, (3) to suggest processes that should be brought under statistical control or which should be otherwise improved.

The process is one which must be repeated frequently. If everything worked right all the time and management utilized the most economic tools, equipment, and technology available, quality would be consistent, productivity high, and costs low. This knowledge leads logically to a way of managing business so that people are trained in problem identification and given problem-solving tools to eliminate unnecessary work. Major barriers to eliminating wasted time are the lack of desire to work at improvement and the lack of knowledge and understanding of variation.

The Human Relations Program creates a climate whereby employees at all levels work together to make constant improvements in operations. This phase is vital in order to establish in employees the key ingredients to accomplishment, which are the will to do it, the belief that it can be done, the know-how, and the actual doing. It starts with the Chief Executive Officer, who must lead and support the program constantly through successes and failures. The purposes of the Human Relations Program are (1) to develop cooperative spirit among employees at all levels and (2) to help make all other areas of a quality system work. The next component is the broad use of statistical methods and industrial engineering techniques.

Statistical Methods

The broad use of statistical methods has three main parts:

1. Determining the businesses, products, and services to be marketed as a result of market research, customer surveys, technical and

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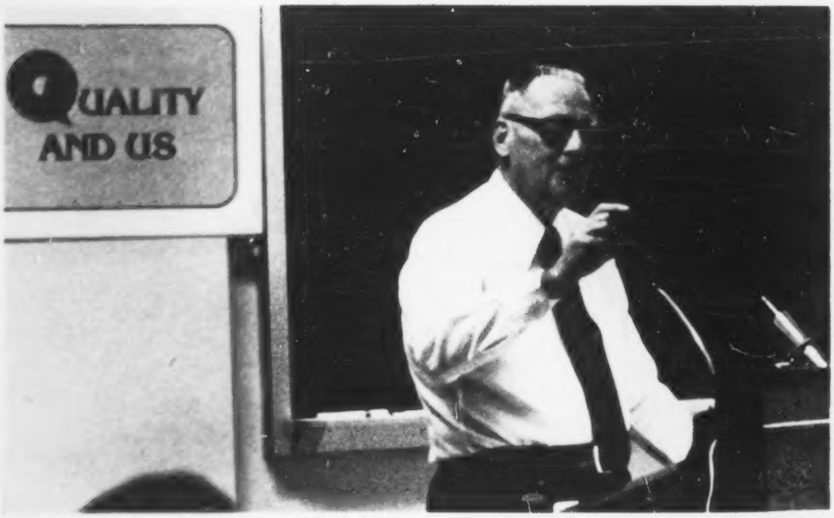
William E. Conway, speaker, consultant, and distributor, was Chief Executive Officer of Nashua Corporation in Nashua, New Hampshire, from 1979-1983. He has been active in promoting quality and productivity, giving strong emphasis to statistical quality control and the teacnings of W. Edwards Deming. He formed Conway Quality, Inc., in Nashua in April 1983.



The major fundamental gains in product quality are made through project management with the use of sophisticated statistical methods, along with human relations and simple statistical tools. V. E. Anderson of Eastman Chemicals discusses with his plant employees the techniques learned at the Quality Control Institute.

manufacturing surveys, and capital availability. The purpose of this part is to determine on which area to work.

2. Using simple charting techniques to define and solve problems. Techniques employed include using charts like the Pareto (bar chart ranking problems or opportunities available to work on); fishbone, (diagram showing cause and effect); run, (time plot of events); flow, (steps in a process or system); correlation, (relationship of one variable to another); and histograms (chart showing distribution of values). The purposes of these simple statistical methods are (a) to solve problems except where sophisticated statistical tools are required, (b) to raise productivity, lower waste, reduce costs, eliminate errors and complexity, and (c) to complement industrial engineering techniques.

3. Using more sophisticated statistical tools such as statistical control charts, statistical analysis, and design of experiments to solve complex problems, particularly in manufacturing and technical areas. The purposes of these sophisticated statistical methods are: (a) to develop consistent quality products and services with low cost, (b) to solve problems requiring advanced statistical tools, particularly in industrial process control and assembly or finishing operations, as well as in research and development and engineering experiments, tests, and trials.

Project Management

The major fundamental gains in product quality are made through project management with the use of sophisticated statistical methods, along with human relations and simple statistical tools. Without the thorough and continued use of these methods, one cannot become competitive in quality and productivity with similar Japanese products today.

The broad use of industrial engineering techniques consists of a major program in all areas of the business to simplify work, improve efficiency, and reduce waste, using the standard industrial engineering tools for work measurement – methods analysis, materials-handling, plant layout, and work simplification. These industrial engineering techniques are used to help solve problems everywhere, particularly on productivity and waste. This requires heavy human relations input. The techniques also complement simple statistical methods.

Total Quality Control

The most successful Japanese companies are now and have been utilizing these integrated programs, particularly in manufacturing, R&D, and engineering, for ten to thirty-four years. In most cases the programs are cumulative in that they build on themselves and on each other, thereby constantly moving to new higher levels of quality and productivity. The Japanese often call this new system Total Quality Control. It should be noted that the Human Relations Program, use of simple statistical tools, use of industrial engineering techniques and use of Imagineering are mutually reinforcing. While use of any one part is helpful, the use of all parts together is tremendously powerful.

These factors are extremely effective in administrative, service, or sales activities. For instance, KANBAN, or Just-In-Time Inventory Control, is built using this new way. The Japanese, who developed KANBAN, are famous for extremely low inventories. Low inventories keep down costs and waste, without compromising operations or losing money. Similar approaches will make an accounts-receivable collection program much more effective. The system readily attacks errors and complexity. An industrial engineering and/or statistical analysis of selling or service activities will usually reveal large areas in which quality and productivity improvements are needed.

The use of these principles does not alter the need for financial controls, good research and development, strong capital base, or many other business activities. This new method greatly enhances the effectiveness of all employees in working together to solve mutual problems, and the use of sophisticated statistical tools assists management to raise quality to high and consistent levels. These levels can be achieved and maintained only by the use of statistical methods. Organizations that have used the method have seen vast improvements in both quality and productivity. ■

Statistical Process Control

CASE STUDIES

(Editor's Note: Following are articles written by representatives from four industries, relating their experiences using Statistical Process Control.)

1. BUICK

William W. Tennent

At Buick, the decision to go with Statistical Process Control was not made quickly or easily, but as we looked toward the future, we began to realize that doing business as usual would not be sufficient anymore. Once the decision to change was made, we started to explore the avenues available to carry us to our desired destination. As this thought process was initiated and the different programs were considered, it became apparent that Statistical Process Control was at least a legitimate contender as a program designed to bring about the desired effects. The initial feature which made it so attractive was that it was a proven winner. Recognizing the urgency of the need for change, we decided that much could be gained by going with a program with a proven track record as opposed to experimenting with one of many unproven methods being marketed today as saviours of industry.

Making a Plan of Action

After the decision was made to go with SPC, it became apparent that we would need a definite plan of action in order to implement it, which meant a drastic change that would have to be sold to the work force. In most industrial environments the work force has seen a significant number of quality programs come and go; therefore, if this program were to be successful, employees had to be convinced that it was necessary, that it would work, and that it was going to be here tomorrow and the day after.

To set this plan into operation, we decided on a series of meetings with upper management and the entire work force. Billed as "State of the Business Meetings", they introduced the work force to three key concepts: quality, cost, and schedule. These concepts and how they related to our staying in business provided the groundwork for an awareness and concern in the work force that was not present before. People started to realize that change was necessary if we were to continue, and they were told that if it were to be a reality, we all must be involved. This particular phase of the operation was probably enhanced because it was painted against a backdrop of economic depression, with area unemployment in excess of 20 percent.

While this awareness program was going on, we were studying, analyzing, and deciding how we wanted to implement SPC in our plant. It was decided that if the program were to be a viable, valuable asset, it would have to be implemented at the operator level. Logically, if this were to be accomplished, all the operators had to be trained in the procedures. Thus, we decided to utilize The University of Tennessee Institute for Productivity Through Quality program to train the trainers. This program gave us a good overview of the philosophy behind SPC and a good working knowledge of the basic tools necessary to get the job done.

Our specific plan called for us to start slowly in a particular area and get our feet on the ground. We believed that if we could achieve some initial success in a controlled environment, we could use it as an example for the rest of the plant. For a variety of reasons, we decided to go into our crankshaft area. This was an area that had tremendous potential in terms of quality improvement, but it was not a particularly friendly area in terms of hourly worker/management relations. Whatever drawbacks we might have created by choosing this area, we did accomplish our goal of achieving some initial success. This positive accomplishment cannot be overstated in the effect it had on our sales program and on the rest of the

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William W. Tennent, Plant Manager of the Buick Engine Plant in Flint, Michigan, has worked for the corporation for eight years, with three years' experience in the foundry and the last five in the engine plant.

work force. For years this area had been indifferent when it came to quality. Now it was performing with the very best production areas on our standard quality measuring stick, the Corporate CPA 145 Audit.

Resistance to Change

It would be nice to say that everything ran smoothly from there on out, but this project, like all projects which are worthwhile, required work and patience. If we had known just how much, we might have had second thoughts. Opposition came from some of the most unlikely areas, specifically from the union and management. The area from which one would have suspected significant opposition, the hourly work force, was really the most supportive, and was, in fact, a positive influence on the other two major groups.

In the final analysis, both the union and the management people who resisted this change were behaving like typical, normal human beings. Perception is a first cousin to reality, and maybe more important. If people perceive something as positive and beneficial, they embrace it and support it. If they feel threatened or don't really understand it, they resist it. The realization that the only real, profitable change will be change that comes from within put us back into the sales program. We used a variety of different sales pitches with all the varied groups. Consistently, our best sales pitch was made by the people on the floor who were using SPC and meeting with much success. If there is one key to resolving these types of problems, it is communication and a sincere desire to understand the other person.

Simultaneously with the selling program, the training program was moving full speed ahead. We had committed ourselves to a program of training and nurturing. The trainers would train the people in a twenty-hour package and then would work with the people on the floor to implement it on their jobs.

There are still some skeptics, but for the most part, our people have accepted the program and are participating at a very high level. The twenty-hour training sessions have been a very costly but very effective tool in selling and implementing the program. Most of these sessions were conducted away from the plant, providing a more relaxed atmosphere for the class. This method conveys the idea that management is committed to the program and, more importantly, is concerned and interested in the individual and what he has to say. For many of these people it was the first time anyone had asked them for their opinion or exhibited any direct concern for them. The union people were also beneficial in this area, since they were directly involved in the sale of the program to the people.

Employees at Buick consult range and average charts.

Our goal is blanket institutionalization, but it still requires a tremendous amount of work. There are probably many things we did wrong, or at least could have done a better job with if we had to do it over again. The most significant of these is that we probably tried to do too much too fast. We stated that our goal was to train and to nurture an area. We trained the areas well, but we did not nurture them as well as we should have. In some areas we got the nurturing processes going and then we left, thinking they could stand alone. We were wrong. The nurturing process needs to be given more importance and should never be terminated.

Improving Communication

Another area that can always be improved on is the area of communications. Very seldom does everyone who needs to know hear about the SPC program. Irreversible damage can be done by making the assumption that everyone knows what is going on and why. This can be avoided only by a concerted and conscientious effort to communicate the pertinent information to the proper individuals.

Obviously, the implementation of Statistical Process Control in an industrial environment is a complex and unpredictable situation. The more intensely people want change, the easier it will be to implement. The broader the support base is, the easier the program is to sell. We must constantly be aware that we are dealing with perceptions, and that they are as important as reality.

If there is one important thing that can be singled out from all the rest, it would have to be leadership. Without the proper leadership, this program will not go. In this case, the word "proper" should be interpreted as dynamic, credible, and people-oriented. When leadership genuinely cares about the people and communicates this, the people will be more tolerant of mistakes and more willing to give of themselves. If the parties involved in the change commit to building bridges based on what they have in common rather than driving wedges between their differences, any program can be implemented. ■

2. ALCOA

Jack Winters

and

Jim Ericksson

The concepts of Statistical Process Control (SPC) are refreshingly logical. Why has it taken us so long to accept them? Reasons include management's reluctance to seek and use hourly impact, and suspicion about the possible negative use of SPC. Some workers may feel that it might be some type of gimmick to check up on them – a sort of "report card" designed to catch a worker making mistakes. Then there is the Japanese connection. While SPC is an American idea, let's face it – the Japanese made it famous. And American workers get tired of hearing about Japanese production. In actual use, however, SPC helps further the interests of the American industrial worker and management as well.

Problems in the Decision-Making Process

U.S. industry has an essentially untapped reservoir of experience, wisdom, and skill which can be used to solve many quality problems. That reservoir is the group of employees closest to the production process – the operating and maintenance crews and first-line supervision. But most plants operate under a system in which this group of employees who are closest to the action, who know the problems intimately, and who frequently know solutions, are largely left out of the decision-making process. Their comments about equipment problems may be taken as complaints; suggestions may be treated lightly or ignored. They are often told what to do and how to do it; they have little authority to make change; and they are vulnerable to blame. Is it any wonder some employees may take less than whole-hearted interest in their jobs?

Statistical Process Control can turn around this wasteful situation. SPC uses accurate data collected from production processes and, through teamwork, utilizes that data to eliminate problems and thereby improve the process.

At Alcoa's Tennessee Operations we are just beginning to use SPC. First, a joint steering committee was formed to plan how SPC would be implemented. Then, Alcoa took advantage of its proximity to the University of Tennessee for all of the steering committee members to attend the three-week SPC course. Most managers attended the one-week session as well. In addition, U.T. professors conducted several seminars at the plant and others are planned for the future.

The steering committee also organized several trips to plants in other industries where SPC is being used. Members visited a Sherwin-Williams paint factory in Richmond, Kentucky; a Buick engine plant in Flint, Michigan; Armco Steel's Middletown Works in Ohio, and others as well.

At the Sherwin-Williams factory, employees had decided what data they wanted to chart in putting SPC to use. And it was working; not only were all employees involved, but real problems that had persistently plagued the operation were getting solved. For instance, charting showed the cause of the biggest downtime on one piece of machinery, and it was the operator of that machine who wanted to find out for himself what caused the problem.

> ***. . . Most plants operate under a system in which . . . employees who are closest to the action are left out of the decision-making process.***
>
> ***At the plants where SPC seemed to be working best, hourly employees were working hand-in-hand with management in training and implementation.***

Jim Ericksson is Production Manager at the West Plant, one of ALCOA Tennessee Operation's two fabrication plants where aluminum is finish rolled.

Jack Winters is a South Plant electrician at ALCOA Tennessee Operations. He is a representative of Local 309 of The United Steel Workers of America and a member of the SPC Department.

He said that the charts proved to management that the source of the problem was just what he had been saying all along. The difference? This time they listened, because the operator had the facts to back him up right there on the control chart.

One key element of success was evident at all the plants members visited. At the plants in which SPC seemed to be working best, hourly employees were working hand-in-hand with management in training and implementation.

In-house Training

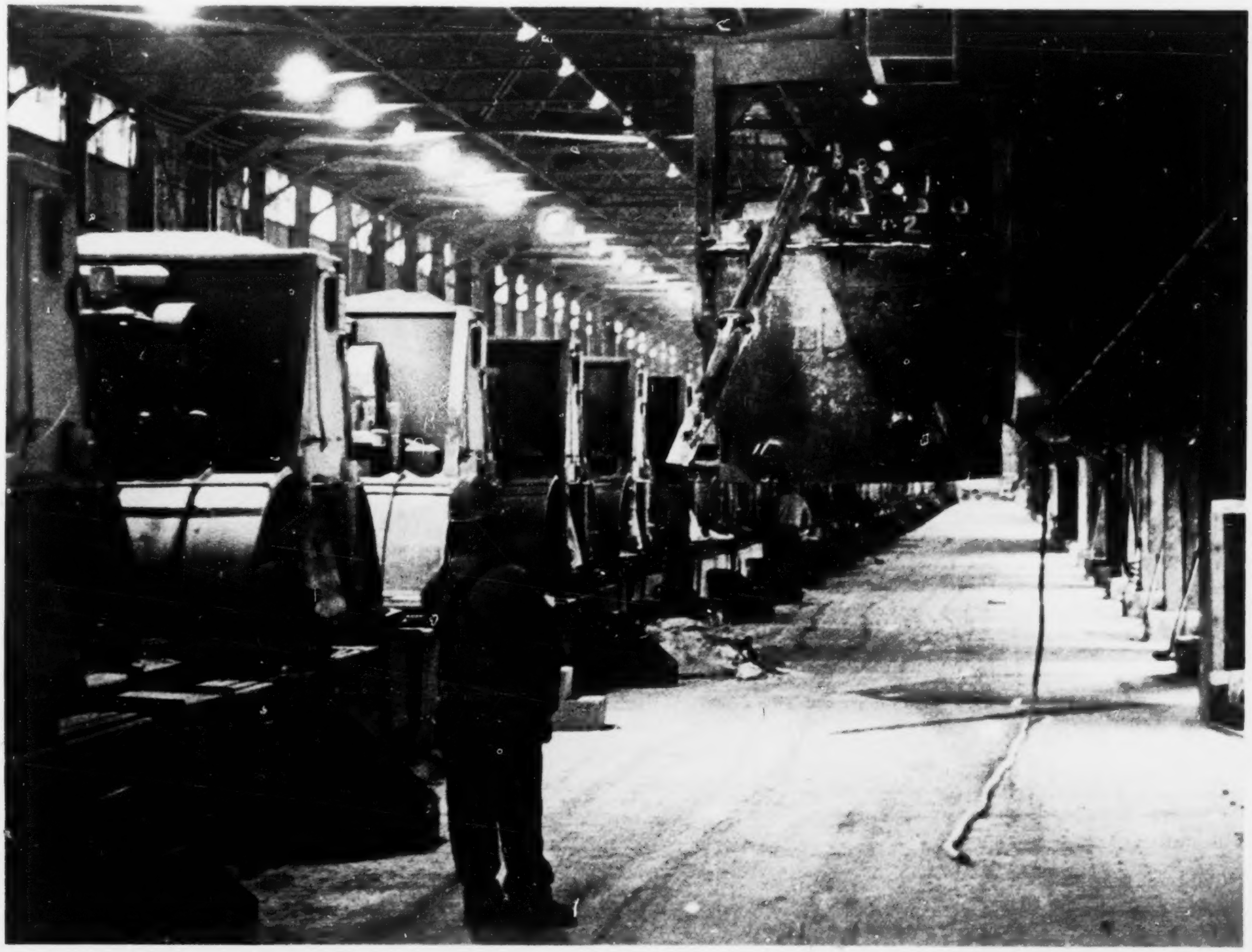
Early on, it became apparent that in order to train almost 4,000 employees, we needed to develop an in-house training capability. We assembled a 24-hour curriculum, with steering committee members as instructors, and seven work teams were trained for the initial implementation phase. Then a permanent, six-person SPC department was formed, including three hourly employees who were active on the steering committee. This department acts as a resource to the line organizations.

Training of the first implementation teams has just been completed. They consist of natural work teams, including operating crews, supervision, maintenance, and staff support.

The implementation teams now have the go-ahead to decide what to monitor and to begin routinely collecting and plotting data. They have the authority to take necessary action when a change in the process is indicated by the charting procedures learned in the class, including shutting down the equipment. The teams will prioritize action which should be taken in an effort to continually improve their process. A major challenge will be to encourage the management organization to be more responsive to the teams' needs.

SPC is a natural extension of a program called "Trust and Cooperation" that has been going on for about four years at Alcoa Tennessee. The joint union/management effort has resulted in a turnaround from almost certain plant closing to corporate approval of money to modernize the facility.

We know that teamwork will work wonders. The possibilities are unlimited now that SPC has added scientific principles that the whole work force can apply to their jobs. ■



A view of the aluminum smelter at ALCOA's Tennessee Operations, where implementation teams have the go-ahead to decide what to monitor and to begin routinely collecting and plotting data.

3. McCORD WINN

William J. Ownby

During the late 70s, it became apparent at our plant, McCord Winn, Inc., that we were going to have to change our method of operation because of increased emphasis being placed on quality by the automotive companies, not only to compete with foreign competition, but also to satisfy the American consumer, who was becoming more conscientious about the overall quality of automobiles.

The Cookeville plant, a subsidiary of Ex-Cell-O Corporation, is a supplier to the original equipment manufacturers of the automotive companies. We are a highly integrated manufacturer of blow-blow-molded plastic windshield washer systems; fluid-level sensing devices for various applications such as washer systems, radiator overflow tanks, power steering, brake sensors, etc.; horn pads; fuel transfer valves; three- and six-port valves for motor-operated or solenoid-operated valves.

Positive Programs for Improvements

At a top management meeting of Ex-Cell-O, the Chief Executive Officer issued a directive for each unit of the company to look for a positive program that would ensure quality improvements. These programs would be implemented utilizing employee involvement programs, resulting in long-term productive improvements through high quality standards. Several different programs were studied to see which would be the most beneficial to our operation as well as which could best be implemented. During this time, we studied Quality Circle Concepts, Employee Participation Teams, and the Statistical Process Control techniques that were being brought out again by several companies and people such as Dr. W. Edwards Deming.

We decided that Statistical Process Control techniques would be the most effective tool that we could use in our plant, so our next step was to locate a source for the education necessary to implement this program. Then, during the summer of 1981, The University of Tennessee, Knoxville announced its program, "The Institute for Productivity Through Quality," utilizing Statistical Process Control Techniques.

The Vice President of Operations of the Cookeville plant attended this three-week, intensive training program in the fall of 1981 and was convinced that the techniques would be of great benefit to us. In early 1982 we made an agreement with The University of Tennessee Personnel Department to conduct a 40-hour program in Cookeville, Tennessee on Statistical Process Control Techniques. Personnel attending this course included department managers, engineers, all first-line supervisors, quality control engineers, and all quality control hourly inspectors (which included most of the union officials). In an attempt to eliminate any apprehension on the part of hourly employees, we also brought the instructors from U.T. back to Cookeville for an eight-hour overview of the statistical techniques for every hourly employee. Attendance was voluntary.

New Concepts for Quality

In 1982 it became apparent that if a company did not have a Statistical Process Control program underway by the 1984 model year, they would not be allowed to participate in quoting jobs for the 1986 model year. Since our business is 100 percent automotive, it was imperative that we move ahead with our program in order that the long-term program be fully implemented and for us to be recognized as a *high* quality supplier to our customers.

Statistical Process Control Techniques are tools that force management action to solve problems; therefore, we instituted a number of new concepts.

We continued training by sending our Quality Control Engineer, Manufacturing Manager, Quality Control Manager, Quality Control Supervisor, and General Foreman to the three-week training sessions at The University of Tennessee.

Our in-house training is conducted by our Statistical Process Control Co-ordinator on a continuing basis. The first level of in-house training involved the basic use of calculators with our control charts. The next level of training will involve establishing control limits on various types of charts, running tests on charts, doing frequency distribution studies, and examining process capability. From there we will progress into improving the problem-solving skills of our employees.

The Cookeville operation's Statistical Process Control Program was initiated as a management effort to utilize the talents and skills of all employees by identifying and resolving manufacturing problems and improving in-plant cooperation and attitudes. Techniques used in the program have been around for years and have changed very little, but the actual use of this valuable method of analysis has been sadly neglected. Each stage of the concept, however small, is another step toward implementation of a complete program. As the management group becomes more familiar with the requirements for installing and maintaining the statistical program, a feeling of confidence grows. The confidence is transferred to the line supervisors and, in turn, to the worker who generates the required information.

Identifying Problem Areas

The Cookeville Operation began implementation of Statistical Process Controls on a job-by-job basis, choosing those with the most obvious problem areas. We are monitoring the following processes utilizing P (proportion of success) charts and $\bar{x}$ (average) and R (range) charts.

William J. Ownby, Vice President of Operations at McCord Winn Division of Ex-Cell-O Corporation in Cookeville, Tennessee, has twenty-three years' experience in manufacturing in the areas of production, maintenance, and plant engineering and expansion.

(1) Blow effort of the horn pads – $\bar{x}$ & R charts
(2) Proper function of the horn pads – P charts
(3) Surface defects of the horn pad cover – P charts
(4) Windshield washer reservoir weights – $\bar{x}$ & R charts
(5) Windshield washer pump performance – $\bar{x}$ & R charts
(6) Nut torque $\bar{x}$ & R charts.

Our program is showing very positive results despite the International Association of Machinists' published objections to any form of participative management programs and the local union's initial objections to the program applied in our plant. As employees become aware of the improvements through problem solving using statistical techniques, a more personal attitude toward job performance has developed. Increased familiarity and understanding of our program is reducing employee resistance to participation. As our employees receive training in this program, their fears and misunderstandings are dispelled and replaced by enthusiasm displayed in the form of operation improvement suggestions, more conscientious work attitudes, and genuine interest in the company's welfare. Although employee participation programs do not lend themselves to immediate or direct financial returns, which can be impossible to accurately evaluate, employee motivation can produce remarkable long-term monetary gains.

There are many ideas and suggestions that have effected improvement in both quality and profitability of our product, including:

(1) Use of machine-cut rather than hand-filed flats in blow molding extrusion dies.
(2) Design of a new clamping system to reduce the time spent changing extrusion dies. This system will reduce the time necessary to change dies by approximately 50 percent.
(3) Redesign of our blow molding mold specification quote sheet sent to our vendors when quoting new molds. These specification changes reflect employee suggestions on improved design that will reduce overall set-up time.
(4) Use of scratch-resistant coated blow mold extrusion dies and core pins to prevent carbon build-up.
(5) Installation of a workable recirculation system for cooling water used in injection molding. The estimated annual savings will be $12,000.
(6) After establishing control charts on the blow effort of our horn pads, an out-of-control process was observed which was attributed to the steel used for the contact plates in our horn pads. We have now tested a different type of steel, with improved results in the blow effort.
(7) Another problem affecting blow effort on some of our horn pads seemed to stem from the foam that fits between the contact plates. A redesign of this part with new dimensions and tolerances will improve the quality of our horn pads.

Production line worker at McCord Winn

Unlike many programs which can be enacted with minimum effort or time spent, an effective Statistical Process Control program requires many hours of planning and very careful implementation. Our future goals involve continued training in the use of Statistical Process Control techniques. The more employees we have involved with this program and the greater their level of training, the more problems we can address and the more processes we can improve, thereby giving us an advantage over our competitors in both the pricing and quality of our products. ■

4. EASTMAN

V.E. Anderson

In recent years, quality has become a vital factor in business competition, resulting in increased customer demands for products of higher quality and less variability. Management has been issued a clear challenge to meet these demands.

Eastman Chemicals Division, supplier of chemicals, fibers and plastics, is meeting this challenge by utilizing sound quality management principles and statistical techniques. Traditionally, management has concentrated on maintaining profit margins by decreasing manufacturing costs and increasing productivity. Although this method holds down manufacturing costs, it is not sufficient to meet new quality demands. By more effectively projecting customer needs and placing an emphasis on quality through *prevention* of defects and *continual* improvement of product quality, the challenge is being met.

Quality Philosophy

Customers buy from the supplier who provides the superior product value. Realizing that value encompasses quality and service as well as price, the Eastman Chemicals Division has established a Quality Policy, which describes management principles and elements necessary to achieve the division's goal of being the leader in product quality and value. This goal is supported by two quality management principles which must be applied to all areas of the company.

The first principle is that current level of performance can always be improved. The company will continually strive to improve quality and reduce costs through improvement projects based on customer quality needs and internal manufacturing needs.

Prevention Areas

The second principle is that prevention of defects is more cost effective than detection and sorting. Emphasis is placed on prevention of problems by removing causes rather than by treating the symptoms. Prevention of problems requires a teamwork approach among all functional areas, including marketing, manufacturing, purchasing, research, engineering, and maintenance. Statistical process control, with emphasis on control at every step of the process from material purchase through product delivery, is an operational necessity.

The strategy for continual improvement of quality is to first achieve statistical control of the manufacturing process. In order to emphasize the importance of statistical control, an operational policy is developed. This policy states that every process will be controlled to the desired target within the process capability. The target of a process is established based on customer needs, and the process capability is the least possible level of variation of the process. Achievement of this operational policy is top priority and is being realized through the implementation of statistical control systems. These control systems monitor the process and allow operators to quickly identify and remove the causes of process upsets.

The second step in the strategy for continual improvement is process optimization and process improvements. This results in superior levels of quality and performance as well as maximum utilization of existing resources. Similar strategies for continual improvement apply to all other nonmanufacturing functions. The final result of these strategies is consistent high quality products of superior value for the customer.

Quality Elements

The Quality Policy outlines 11 elements of quality management that are essential to the success of our improvement efforts.

1. *Management leadership and involvement.* Management support is required to establish the importance of the improvement effort, to provide the necessary resources, and to facilitate cooperation among functional areas. Without leadership and involvement by top management, the remaining 10 elements could not be implemented.
2. *Use of statistical process control techniques.* Use of these statistical methods allows Eastman to identify important in-process variables on which to focus control and improvement efforts. Process capabilities must be well defined so that changes in the process can be quickly identified and corrected. Statistical process control efforts emphasize the prevention of quality problems during manufacturing.
3. *Manufacturing information systems.* Computer technology enables Eastman to have real-time, on-line data communications at the operator's workplace. Operators utilize manufacturing information systems to analyze and interpret process data using statistical methods. Manufacturing information systems allow all personnel to identify areas which have the most potential for improvement, and are used to provide objective measures of accomplishments.
4. *Training of all personnel in job functions, quality responsibilities, quality disciplines, and statistical methods as appropriate to their job assignment.* Employees from top management through hourly roll employees must have the skills needed to properly carry out their functions and quality responsibilities. Companies which have all personnel using the appropriate quality disciplines, including statistical methods, have the competitive edge.
5. *Teamwork among all functional areas and organizational levels.* Quality improvement is not the domain of any one functional area or organizational level. Each functional area and organizational level must jointly contribute to the common goal of continual quality improvement.
6. *Long-term relationships with customers and suppliers.* Long-term relationships with customers are essential to assure that product quality consistently meets customer requirements. Communications must be open, and information on problems, needs, and solutions must be shared. Establishing long-term relationships with suppliers helps prevent defective raw materials from reaching the process. By working as a team with suppliers, a company can solve problems and improve quality of raw materials and incoming materials.
7. *Involvement of all employees in continual improvement through annual improvement goals.* Every employee must contribute to quality improvement in at least two ways. First, each employee must perform his or her job to produce the best possible quality. Second, he or she must be involved in generating ideas to improve quality and in implementing these ideas. Open communication – free from fear – is required. Employee ideas and efforts represent tremendous resources. Eastman has used performance management, foremen teams, and a company suggestion system to utilize these resources. Through participation in the quality improvement effort, employees are becoming more proficient in problem-solving and the quality disciplines.
8. *Quality cost systems.* Systems which quantify the cost of poor quality are essential to the identification of improvement opportunities. They also aid in the efficient allocation of resources as well as provide good measures of the effectiveness of quality management efforts.
9. *Short-term decisions consistent with long-term goals.* The goal of being the leader in product quality and value cannot be jeopardized by shipping products to customers that may not meet their needs. Short-term profits may suffer at

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V. E. Anderson is Executive Vice President and Works Manager of Tennessee Eastman Company, the largest manufacturing unit within the Eastman Chemicals Division of Eastman Kodak Company. Mr. Anderson, along with other members of management, is intimately involved with the planning, teaching, and feedback phases of quality management.

times when expenditures are made for quality improvements or when a questionable product is rejected. This element not only applies to manufacturing areas but to all company functions.

10. *Performance standards that focus on both quality and productivity*. Work standards which emphasize productivity without considering quality cannot be tolerated. All performance standards must support the goal of being the leader in product quality and value.
11. *Competitive quality intelligence systems*. Competitive quality intelligence systems provide information to project improvement opportunities for Eastman products.

Implementation Approach

Eastman's Quality Policy establishes a clear need for quality management within each manufacturing area or division. Quality Management plans developed for each area direct the efforts to achieve the operational policy and to support the principles of continual improvement and defect prevention.

The initial implementation phase of quality management emphasizes the use of statistical process control techniques to attain control and to optimize the economic and quality factors of the manufacturing processes. Upon achievement of control and subsequent optimization of existing processes, further opportunities for improvement with respect to quality and cost of operation are more easily identified These opportunities provide the basis for improvement projects that support continual improvement.

Implementation of the Quality Policy is executed by the existing line organizations. Each line manager has established a resource committee to facilitate implementation and long-range planning. The resource committees exist at company, division, and department levels.

The Quality Management Committee at the company level, chaired by the Works Manager, includes top management of all functional areas as well as the Quality Management Program Coordinator. The primary function of this committee is to establish manufacturing goals and review division progress. The objectives of this committee are to (1) develop goals for product quality and quality costs, (2) assist divisions in the development of quality control programs and organizations, and (3) establish a program of regular quality management reviews.

Each Division Quality Management Committee is chaired by the appropriate Division Superintendent and usually includes as members Assistant Division Superintendents and other members which best suit the formal organization. Primary committee functions are to (1) provide goals for quality improvement, (2) formulate the overall quality management plans for the division, (3) establish implementation strategies, and (4) establish and monitor indices that reflect quality performance.

Each Department Quality Management Committee is chaired by the Department Superintendent and usually includes representatives from Quality Assurance and other staff functions and appropriate area supervisors. The primary functions of these committees are to (1) formulate the quality management plans for the department within the boundaries established by the Division Quality Management Committee plans, (2) establish implementation strategies, (3) establish projects to support the division quality improvement goals, (4) establish and monitor indices that reflect the performance of the department quality management plans, and (5) appoint and monitor the progress of project teams for the achievement of specific projects.

Control Systems

Statistical Process Control teams involving many company functions, discplines, and organizational levels have been formed to design statistical control systems for raw materials, measurement, process, and product control. These control systems are designed to be operated by the person who can provide immediate reaction. If these control systems do not provide an acceptable product system, then breakthrough teams are established which have the responsibility for improving the product system.

The implementation of quality management is not an easy task, and Eastman is by no means finished. Implementation efforts to date have required a considerable amount of training.

Training began as the Works Manager and two Assistant Works Managers led a one-week Quality Management Workshop for all Manufacturing Division and Department Superintendents. Managers from all functional areas also participated. In the opening workshop, the Quality Policy and the organizational roles of each functional area within the company were discussed, and the concepts of control and breakthrough for achieving quality improvement were presented. Each manufacturing division has since developed its own quality management plans which address the following questions:

1. *How will annual goals be established?*
2. *How will quality improvement opportunities be identified and priorities established?*
3. *What training is needed and how will it be given?*
4. *What support will be needed from other functional areas of the company?*
5. *How will progress be monitored?*
6. *How will the participation of all employees be achieved?*
7. *How will customer needs be identified?*

Feedback from the participants has been positive. Management participation in training and continued involvement are projecting the importance that company leadership attaches to quality. Each division management team is continuing to demonstrate leadership and involvement at the lower organizational levels by developing and presenting their own quality management workshop.

Experience has already shown that significant quality improvements can be obtained with minimum capital expenditures. These improvements also increase productivity and reduce manufacturing costs. The key to successful implementation of quality management is top management leadership and involvement. ■

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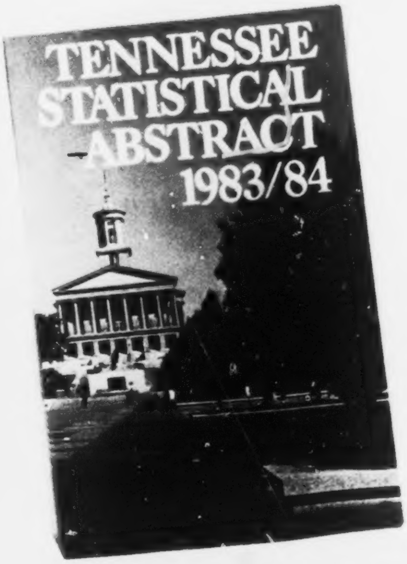

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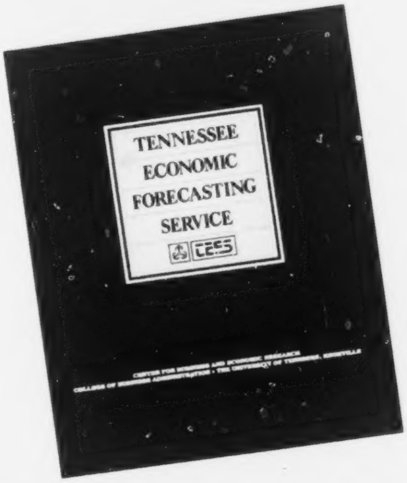

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Industrial Organization and Antitrust Policy

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THE UNIVERSITY OF TENNESSEE, KNOXVILLE

Industrial Organization and Antitrust Policy

> "People of the same trade seldom meet together, even for merriment and diversion, but the conversation ends in a conspiracy against the public, or in some contrivance to raise prices."

Adam Smith: **An Inquiry into the Nature and Causes of the Wealth of Nations.** *Edited by Edwin Cannan. New York: The Modern Library of Random House, 1937 [1776].*

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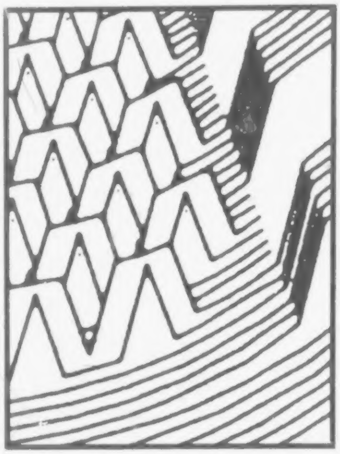

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Cover art from photo of a sculpture by Michael Lance at the apex of the Federal Trade Commission Building in Washington, D.C.

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Consulting Editor's Comments

This memorial issue of the **Survey** is intended to be a tribute to the scholarship, wit, and character of Professor P. David Qualls. Since Qualls spent a good part of his life advancing the field of industrial organization economics through his teaching, his research, and his public service, it is fitting that the papers included here deal with that subject area as well. Moreover, since Qualls' own work was generally conducted with the ultimate goal of improving public policies toward business, it is also fitting that these articles focus largely on the role of economics in formulating and enforcing U.S. antitrust policy.

The articles in this issue are written by individuals who grew to know Professor Qualls through vastly different circumstances. One author is a former student, two are former colleagues from different institutions with which Qualls was associated, and the fourth is a former classmate from Qualls' graduate program. While the four articles are bound together by their common focus on industrial organization economics and antitrust policy, the stronger thread that ties them together is their shared friendship and respect for P. David Qualls.

The introductory article, "Industrial Organization and Its Schools of Thought," is written by David W. Blackwell, who was a student in Dave Qualls' graduate microeconomic theory and industrial organization courses. Blackwell's paper, which is taken from Qualls' introductory lectures in the latter course in the winter quarter of 1984, defines the field of economics known as industrial organization and briefly describes the major schools of thought that exist within this field. This paper is intended to acquaint the reader with the broad research interests and approaches used by industrial organization economists in their applications of economic theory to public policy issues.

The next article, "The Economics of Antitrust Enforcement," is written by Katherine Maddox McElroy and John J. Siegfried. Siegfried was a colleague of Dave Qualls at the Federal Trade Commission in 1976-77 and maintained close personal and professional ties thereafter. This article describes the major role that industrial organization economics has played in shaping and implementing a primary component of the federal government's public policy toward business (the U.S. antitrust laws) and explains the fundamental economic rationale for a policy that promotes competition and discourages monopoly. To support this explanation, the authors survey the economic theory and empirical evidence that connect industry structure to economic performance and describe the roles that economic theory can play both in identifying the structural conditions that are conducive to the formation and maintenance of collusive price fixing agreements and in designing civil remedies that are likely to lead to improvements in industry performance. This article exemplifies the microeconomic/public policy orientation typical of industrial organization economics.

The third article, "Industrial Organization Economics at the Federal Trade Commission," is contributed by William F. Long, who was a classmate of Dave Qualls at Berkley in the 1960's. Long's article describes the organization and functions of one of the two federal agencies that are responsible for the enforcement of our antitrust laws, the Federal Trade Commission, where Qualls worked for five years. The focus of Long's article is the role of the industrial organization economist in carrying out the Commission's legislative mandate to promote competition in the U.S. economy. In describing this role, Long emphasizes the usefulness of economic research in molding public policy in a federal agency. As a specific example, he uses some of the research that Qualls conducted during his tenure at the FTC.

The final article, "Theories of the Multiproduct Firm: Implications for Antitrust Policy," is written by John W. Mayo, who was a colleague and friend of Dave Qualls at The University of Tennessee, Knoxville. Mayo's paper describes some recent advances made within the field of industrial organization that expand our understanding of the economic motivations that lead firms to adopt a multiproduct organization (i.e., to diversify). Mayo then utilizes this survey of the economic theories of the multiproduct firm to derive appropriate public policy responses to recent trends toward diversification through conglomerate merger. Since the survey indicates that some motivations are efficiency based (or are pro-competitive) while others depend upon the utilization or entrenchment of monopoly power, the ideal approach is to differentiate individual cases on the basis of the underlying incentive for diversification. A framework for taxonomizing specific instances of diversification is provided to aid in case selection. Again, the microeconomic/public policy orientation is prevalent.

Qualls' colleagues and those in the field can look forward to the result of his collaboration with Joe S. Bain, the third edition of **Industrial Organization**, which is expected to be published in the near future.

*David L. Kaserman,**
Consulting Editor

**Dr. Kaserman is an Associate Professor of Economics in the College of Business Administration, The University of Tennessee, Knoxville. His experience includes positions at the Oak Ridge National Laboratory, the Federal Trade Commission, and the U.S. Department of Housing and Urban Development. In 1982/83 he was Visiting Associate Professor of Economics at the University of Florida, Gainesville.*

In Memoriam: P. David Qualls

The students, faculty, and staff of the College of Business Administration observe with great sorrow the death of P. David Qualls, Professor of Economics since 1979.

A native of Orlando, Florida, Dave was graduated from the University of Florida in 1960 with a major in economics. He received the Ph.D. degree from the University of California in 1968. While at Berkeley he developed his interests in industrial organization and applied microeconomics — interests that he pursued throughout his professional career. Following graduation from Berkeley, Dave accepted a faculty position at the University of Maryland. In 1974, he began a highly successful five-year period of service in the Federal Trade Commission, where he reached the rank of Deputy Director in the Bureau of Economics.

Dave came to The University of Tennessee in 1979 to serve as Head of the Department of Economics and as a Professor in the Department. He brought to the position of Department Head an impressive set of administrative skills. But it was his leadership ability that was most admired. Dave led the department through a critical period in its history. He made recommendations only after the most careful and thorough planning, and he was always sensitive to the effects that new ways of doing things would have on the people involved. He chose to step aside as Department Head after four years, feeling that it was time to pass those duties to another. Since last August, he had pursued his career as a professor bringing to his teaching and research the same zest he had exhibited as Department Head. The Department will long be in Dave's debt for his leadership.

Dave loved economics and seemed to have an intrinsic sense of how the economy really worked. It is a great loss that he did not have the opportunity to complete more of his research agenda. During his four years as Department Head, the time available to pursue research projects was limited, and to Dave one of the appealing features of life as a professor was the greater availability of such time. It is sad that he was to have less than a year of that scholarly life following his service as Department Head. But it is a mark of the quality of Dave's work that, while the particulars have not been worked out, it seems likely that a major project on which he had virtually completed his contribution will be published later. It is a further measure of Dave's commitment to scholarship that he had recently assumed leadership in bringing together colleagues in the academic world and other professionals in the Industrial Organization Society of which he was President, and in launching the new **Review of Industrial Organization**, the first edition of which has recently appeared.

Due to his fine intellect, his great heart, his warmth and wit, Dave's circle of influence was wide. He will be greatly missed by family, friends, and colleagues with whom he shared the life that he enjoyed so much. Prior to his death in March, 1984, Dave was looking forward to the arrival of spring and summer, when the lakes and the tennis courts provided an opportunity for get-togethers and therefore an attraction that to him was irresistible. We all could take a lesson from Dave in the enjoyment of life. And while his time with us was too short, all whose lives were touched by him are the better that Dave Qualls was a part of our lives.

Charles B. Garrison[*]

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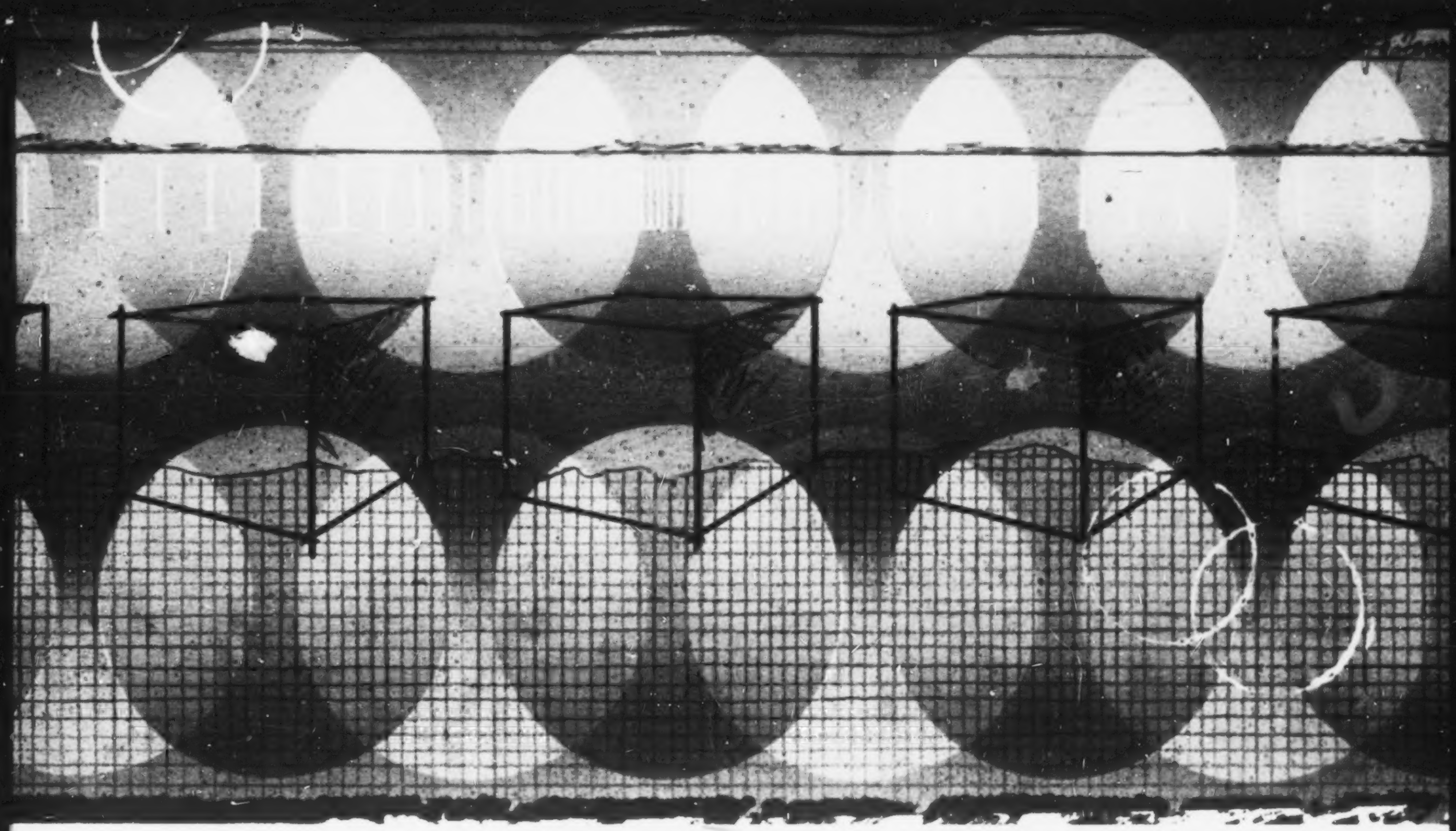
[*]Dr. Garrison is a Professor of Economics in the College of Business Administration, The University of Tennessee, Knoxville.



Industrial Organization and its Schools of Thought

David W. Blackwell

(Editor's Note: This article is based on lectures presented by Professor P. David Qualls in a doctoral seminar in Industrial Organization during winter quarter 1984.)

What is Industrial Organization?

The purpose of this article is to present some alternative definitions of the field of industrial organization, to briefly discuss the research interests of industrial organization economists, and to examine the different schools of thought that have developed in the field.

Several scholars have made attempts to define industrial organization. Some of them define the field quite broadly, saying that industrial organization is the study of how resources are allocated in society or that the field merely represents applied microeconomics. Others choose a narrower definition, saying that the field represents the study of how individual firms behave in the pursuit of profit, i.e. how firms organize their resources to pursue their goals.

In general, there seems to be a universal feeling of frustration among scholars trying to explain what the field is all about. George Stigler begins his textbook, saying "There is no such subject as industrial organization."[1] Certainly, if the field does not exist, one would have a hard time describing it. However, Stigler was merely making the point that the concerns of industrial organization are precisely the concerns of microeconomics, given that industrial organization is the study of the structure and behavior of industries and the effects of these on competition, prices, and resource allocation in the economy. What then, in Stigler's eyes, distinguishes industrial organization from microeconomics?[2] First, economic theory as a formal logic is not equipped to handle the measurement and empirical verification of various constructs and concepts that arise from the theory. Stigler states that it is the aim of industrial organization to undertake these tasks. Second, microeconomics, as pure theory, is not equipped to allow detailed study of "real world" problems; i.e. to study microeconomic phenomena within institutional and legal frameworks. Stigler concludes that the field of industrial organization is sufficiently informal (he says "nontheoretical") to allow "detailed studies of empirical measurement of cost curves, concentration, etc." and for the same reason allows investigation of related "public policy questions--in particular, those proposed by antitrust laws and public regulation."[3] Thus it seems

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David W. Blackwell, doctoral student and a Teaching Assistant for the Department of Finance at The University of Tennessee, Knoxville, was a student of Dr. P. David Qualls for three years. His dissertation will be an empirical investigation of the private placement market for public utility debt.

Industrial Organization is concerned with the study of economics in which supply and demand forces are allowed to determine the allocation of society's resources.

that Stigler's view of the field is rather broad. Stigler would probably refer to the field as applied microeconomics.

Other Views

While no economist would argue against this interpretation of the field, some, such as F. M. Scherer or P. David Qualls, would argue for a narrower and more precise definition of industrial organization. Scherer, for one, shares Stigler's frustration in attempting to define the field and says that the name, industrial organization, "is a curious one, distinctive mainly in its inability to communicate to outsiders what the subject is all about."[4] Both Scherer and Qualls would agree that a primary concern of industrial organization is in the study of how productive resources are allocated and how such allocation affects the welfare of society; however, this statement says nothing more than Stigler's definition of industrial organization as applied microeconomics. Both scholars would favor a narrower description of what the field is all about.[5]

First, industrial organization is concerned with the market system of allocating resources; i.e., industrial organization is concerned with the study of economies in which supply and demand forces are allowed to determine the allocation of society's resources. Second, Qualls emphasized that referring to industrial organization as applied microeconomics may be too broad a definition, given that other fields within economics could make this same claim. For example, labor economics is no less applied microeconomics than is industrial organization, and yet is a separate field, since its primary concern is with the allocation of labor resources in the economy – i.e., the workings of the labor markets. Qualls also contrasted industrial organization with public finance. While both fields can be said to be applied microeconomics, public finance is concerned with the allocation of resources in the public sector of the economy, and industrial organization is concerned with resource allocation in the private sector of the economy.

To be more precise, industrial organization can be defined as the study of the operations of manufacturing, mineral extraction, and service industries and the effects of the operations of these industries on consumer welfare. As such, the scope of industrial organization is in the private industrial sector of a market economy. Thus, Qualls' and Scherer's definitions are much narrower than the broad description of industrial organization as merely applied microeconomics.

Objectives of Industrial Organization Research

What then, does the field of industrial organization purport to do? Basically, industrial organization economists are interested in issues of strong public policy interest; i.e., they are primarily concerned with determining the types of market structures or buyer and seller conduct which will facilitate the best possible performance of the economy. Good performance means that:

1) We do not waste scarce, and hence, valuable resources;

2) Producers of goods and services should take advantage of technological advances which allow them to produce more and better goods and services more efficiently;

3) Producers' actions should facilitate stable, full employment of resources; and

4) Income is equitably distributed among those who provide their resources to society.[6]

There are 2 basic approaches to determining public policies which facilitate good performance of the economy. First, some industrial organization economists devote their careers to developing theoretical models which give rise to public policies that would enhance the economy's performance. Others are primarily interested in empirically testing whether existing public policies are actually improving performance. The main body of scholars in industrial organization is interested in measuring the effects of different market structures and different forms of conduct on economic performance and forming policy recommendations based on these measurements. Examples of policy issues of interest to industrial organization include the decision to regulate public utilities or the attempt to induce competition and good conduct through the antitrust laws.

Schools of Thought

The remainder of this article will summarize the Qualls discussion of the different schools of thought in industrial organization. Each of these schools of thought represents approaches to the study of industrial organization that have their bases in different philosophies of economic reasoning. Qualls' purpose in discussing this topic was not to provide a detailed intellectual and economic history of the development of each of these schools, but to provide a convenient means of classifying scholarly works in industrial organization. These categories are not intended to provide a "pigeon-hole" into which each published article in industrial organization neatly fits, but to give the student of industrial organization some intellectual perspective into the theoretical or empirical approach of each study and the resulting policy conclusions. Thus, Qualls presented these schools of thought as pedagogical tools to assist the student in determining where different studies fit into the field.

Before discussing each of the schools in turn, it should be stressed that the names given to each of the schools are somewhat arbitrary in that Qualls chose to name them based on the location of major figures of each school at a particular point in time. Also, it should be stated that not every industrial organization economist subscribes to any one school of thought in particular; rather, most economists draw upon the best ideas and approaches of all of the schools.

1. The Chicago School

George Stigler, based at the University of Chicago, is said to be the major figure of the Chicago school of industrial organization thought. The basic premise is that, as Stigler says, "competition may be the spice of life, but in economics it has been more nearly the main dish."[7] The Chicago school of industrial organization emphasizes the supremacy of competition in promoting good economic performance. Certainly no economist would argue against the idea that perfect competition, in theory, should satisfy all of the desirable conditions for economic performance; but, the Chicago school has been criticized for making policy recommendations based on the assertion that perfect competition or something close to it exists in the "real world."

The Chicago school is typified by its attempts to apply the model of perfect competition to actual situations. The resulting policy recommendations are essentially for government nonintervention, since the intellectual roots of Chicago school economics are in an earlier offense against "mercantilism" which promoted laissez faire on the part of government and asserted that government intervention into the affairs of industry results in monopoly and the evils thereof. While debates about the sources of government intervention continue, current Chicago economists are more interested in discovering what makes competition really work in attaining the goals of desirable economic performance. If it were fair to summarize the school of thought in a few words, we might say that the Chicago school feels that competition is the natural order of things, and that all markets tend toward that state; if monopoly power is observed to exist, it must be either because a firm is more efficient than its rivals or that the industry is being "protected" by certain government policies.

The Chicago school feels that competition is the natural order of things, and that all markets tend toward that state . . . .

2. The Harvard School

The Harvard school of industrial organization thought developed in the wake of theoretical studies by Edward Chamberlin and Joan Robinson in which they developed oligopoly theory.

These models were highly mathematical and considered unwieldy for use in making public policy decisions. This idea led to the development of a standard for economic policy which was somewhat more realistic than the model of perfect competition. This standard, developed by J. M. Clark, was the idea of "workable competition," which was far from being perfect competition, but which was a reasonable and realistic standard for government economic policies.[8] In the 1930's, Edward S. Mason, renowned as the father of the field of industrial organization, developed a framework which allowed a systematic means of studying an industry and determining the nature of its performance with respect to the workably competitive standard.

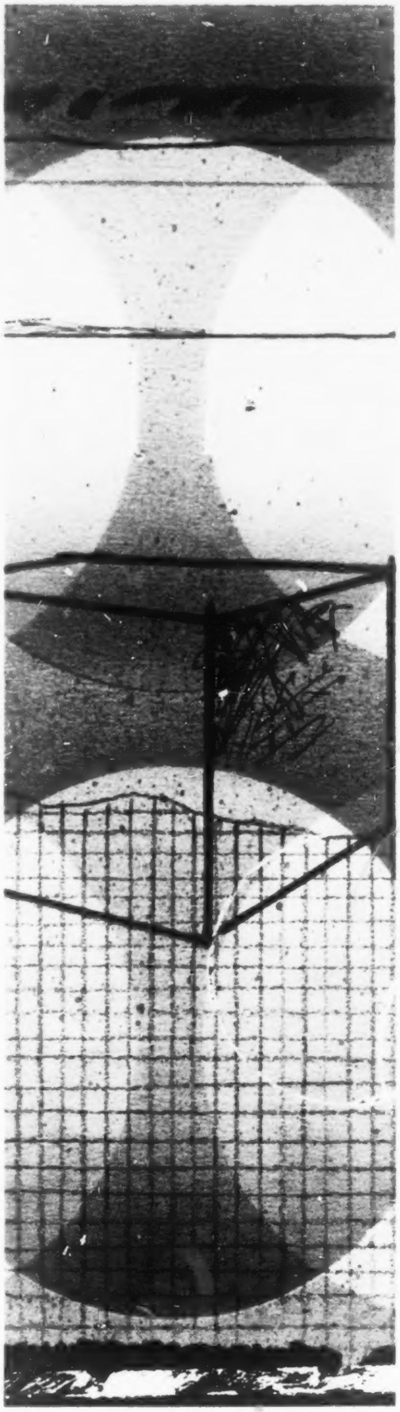
Mason created the structure-conduct-performance paradigm which implies that the structure of industries (at that time, structure was considered to be the number and size distribution of firms in the industry) affects the behavior or conduct of buyers and sellers in the market with respect to their price and output policies. The conduct of firms in the industry in turn affects industry performance measured on the dimension of profitability.

The use of this paradigm resulted in the industry study as a methodology. The industry study is essentially a detailed empirical analysis of an individual industry in the framework of the structure-conduct-performance paradigm. Thus, the Harvard School stressed the application of a more realistic, and perhaps non-theoretical concept of an industry structure which leads to ideal economic performance. The industry study represented an attempt to empirically determine how close an industry's structure is to a "workably competitive" ideal, and based on this determination of industry structure, economists and policy-makers would predict an industry's conduct and hence, its performance so that relevant policy actions could be taken to improve performance if necessary.[9]

3. The Pennsylvania (Carnegie-Mellon) School

The Pennsylvania school of industrial organization thought has its intellectual roots in a famous study by Berle and Means in the 1930's which deals with corporations deviating from the profit maximizing goal because of a perceived increase in the separation between ownership and control.[10] Thus, this school of thought holds that performance is determined primarily by the internal structure and behavior of the enterprise, i.e., the motivations of managers will determine whether or not the firm pursues a profit maximizing goal. Currently, this school is interested in determining managerial motivations and investigating what types of alternative firm goals result from these motivations.

For example, Herbert Simon has proposed that organizations, business firms being an example, do not tend to maximize a single, well-defined objective such as profit, but instead try to satisfy some minimum level of attainment with respect to several objectives. Cyert and March has suggested that firms may try to satisfy conflicting goals by merely trying to achieve one objective at a time, rather than approaching all goals simultaneously.)



Subsequent research has centered around examining different managerial motives and the resulting alternative objective functions that firms seek to maximize and to determine the effects of these alternatives to profit maximization on economic performance. Examples of these alternatives to profit maximization on economic performance. Examples of these alternatives to profit maximization include sales revenue maximization, firm size and/or growth maximization, managerial attempts to seek job security by smoothing out fluctuations of accounting earnings through the use of organizational slack, and managerial maximization of perquisite consumption. Thus, the basic premise of the Pennsylvania school is that profit maximization is not the primary goal pursued by corporations.

4. The Vanderbilt-Wisconsin School

The Vanderbilt-Wisconsin school is characterized by the work of George Stocking and Willard F. Mueller in which they espouse the populist ideals of individualism, liberty, and free enterprise. Their approach to the study of industrial organization is highly institutional in the sense that moral and political principles and not economic theory are used to defend public policy recommendations.

In the eyes of the Vanderbilt-Wisconsin school, firms of large size are dangerous concentrations of economic power which threaten the Jeffersonian ideals upon which our country was built. As such, large firm size is seen to be undesirable in and of itself since it is perceived to be a precursor to monopoly and its evils. While they view the perfectly competitive model as an ideal from the Smithian or Jeffersonian standpoint, they would hold that the model has limited applicability in reality given the preponderance of large and hence, monopolistic firms in the U.S. economy.

Such views led Stocking to reject totally the concept of workable competition as a standard of economic policy, stating that the concept is "at best, useless, and at worst, dangerous."[11] These views also led Mueller to condemn conglomerate mergers as dangerous concentrations of economic power and to propose stringent policy measures to check the activities of large conglomerates.[12]

These views turn out to be the complete antithesis of those of the Chicago school. Chicago school economists can be said to unalarmingly see monopoly as a useful and natural outcome of a firm's efficiency or as the outcome of government intervention, while Vanderbilt-Wisconsin school economists view monopoly as being inherently undesirable.

5. The Berkeley School

Joe S. Bain is the major figure of the Berkeley school.[13] He is a Harvard-trained economist who extended the structure-conduct-performance model developed by Mason. First, Bain differed from Harvard school economists who saw structure as being merely the number and size distribution of sellers in that he saw the elements of industry structure also including buyer concentration, the ease of entry (condition of entry), the degree of product differentiation in the industry, and the overall price elasticity of demand for the industry's product. Bain also extended the concept of conduct to include not only methods of pricing and behavioral coordination, but also such dimensions as non-observable managerial motives (i.e., alternatives to profit maximization).

Bain is also important in that he pioneered a new empirical methodology in industrial organization research. His idea was to apply microeconomic theory to derive empirically testable hypotheses which are generally applicable across all industries.

Bain's primary empirical concern was in testing the relationship between the number and size distribution of sellers in an industry with profits in that industry, and making inferences about the technical and allocative efficiency of industries based upon the structure-profits relationship. Essentially Bain used profits as a measure of economic performance and avoided empirical testing of the effects of conduct on performance, since the paradigm implies that conduct in the realm of methods of price calculation were difficult, if not impossible, to measure.

Scherer refers to Bain as a structuralist because he stressed empirical tests of structure directly on performance. Given testable hypotheses about the relationship between structure and performance, Bain employed empirical tests across industries in order to make more general applicable policy recommendations. As such, Bain ushered in the use of cross-sectional data to make empirical investigations, and this led to the disappearance of the Harvard-type industry study as an empirical methodology.

Bain's approach represents a synthesis of Schumpeter's view that there are both good and bad points about both competition and monopoly with Mason's structure-conduct-performance paradigm. The resulting empirical methodology represents a means for economists who subscribe to the Berkeley school to make policy recommendations based on the merits or demerits of the particular hypothesis (policy question) under consideration. As such, this school considers the merits of each case rather than engaging in wholesale condemnation of size or economic concentration.

Concluding Remarks

It is hoped that these brief summaries of the different schools of thought will help all of those who have an interest in industrial organization to understand more fully the intellectual foundations of policy decisions or scholarly work which they may encounter. In particular, Professor Qualls would want students of industrial organization to have their learning experience enriched by a familiarity with the schools of thought.

Industrial organization economists are interested in issues of strong public policy interest; i.e., they are primarily concerned with determining the types of market structure or buyer and seller conduct which will facilitate the best possible performance of the economy.

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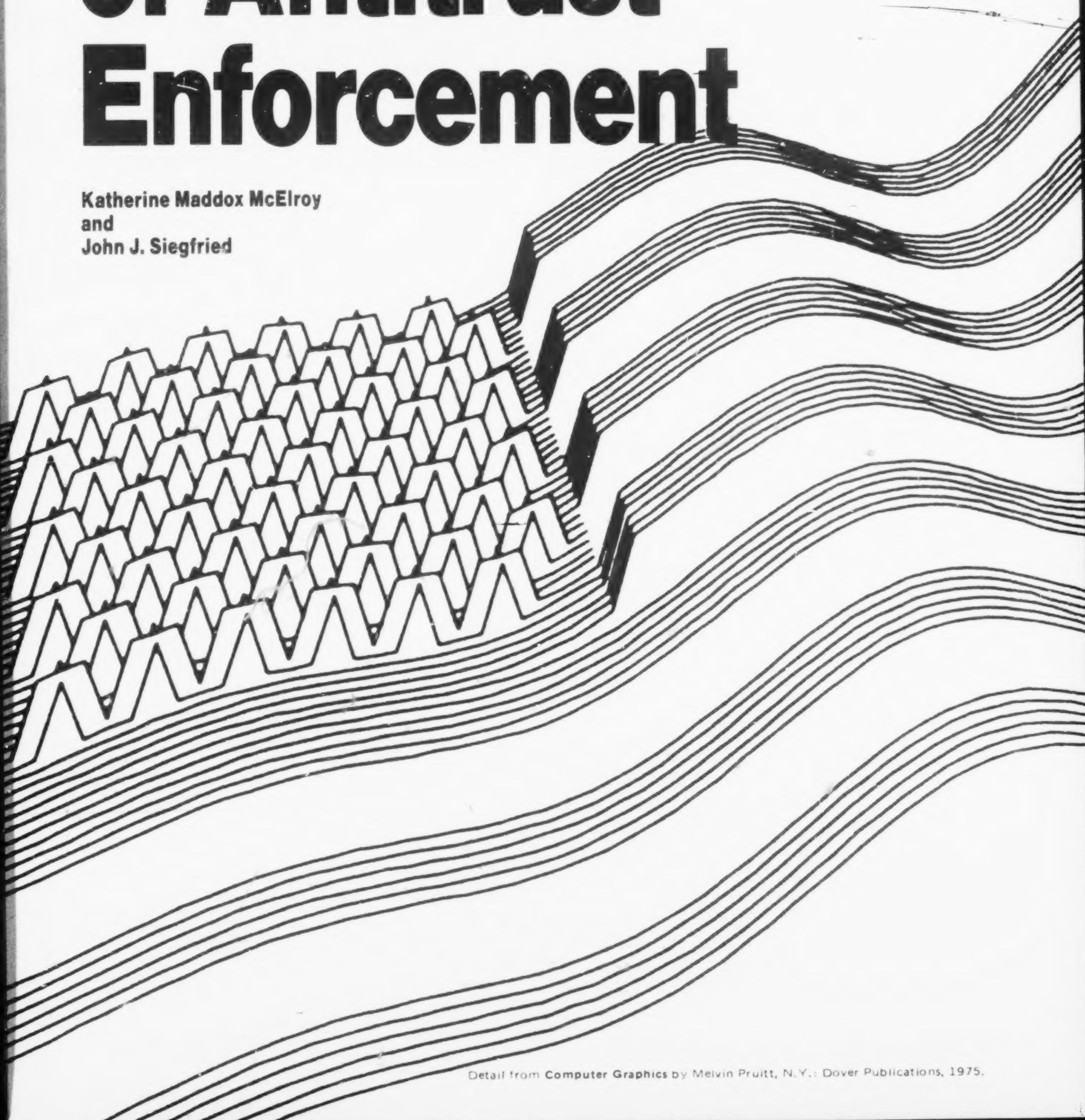
1. George J. Stigler, *The Organization of Industry* (Homewood, Illinois: Richard D. Irwin, Inc., 1968), p. 1.
2. The following discussion of the role of industrial organization is summarized from Stigler, p. 1.
3. Stigler, p. 1.
4. F. M. Scherer, *Industrial Market Structure and Economic Performance*, 2nd ed. (Chicago: Rand McNally College Publishing Company, 1980), p. 1.
5. The description that follows is summarized from Scherer, pp. 1-7.
6. These aspects of performance are paraphrased from Scherer, p. 3.
7. Stigler, p. 5.
8. The development of the Harvard school is discussed in William G. Shepherd, *The Economics of Industrial Organization* (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1979), pp. 19-21.
9. The previous discussion of the paradigm is summarized from Edward S. Mason, *Economic Concentration and the Monopoly Problem* (New York: Atheneum, 1964), pp. 1-10.
10. The discussion in this section is summarized from Scherer, pp. 34-36.
11. Edward S. Mason, Book Review of George W. Stocking, *Workable Competition and Antitrust Policy* (Nashville: Vanderbilt University Press, 1961) in the *Vanderbilt Law Review* XV (October 1962), p. 1347.
12. See Willard F. Mueller, *A Primer on Monopoly and Competition* (New York: Random House, 1970), pp. 176-190.
13. The discussion in this section is derived entirely from lecture notes from Professor Quall's doctoral seminar on industrial organization at The University of Tennessee, Winter 1984. ■

The Economics of Antitrust Enforcement

Katherine Maddox McElroy
and
John J. Siegfried



Detail from **Computer Graphics** by Melvin Pruitt, N.Y.: Dover Publications, 1975.

In just six years the Sherman Antitrust Act will be a century old. This law, which prohibits conspiracies in restraint of trade, monopolizing, and attempts to monopolize, exerts a profound influence on the everyday conduct of business firms in our economy. The law itself is sufficiently vague to provide little guidance for behavior. Judicial interpretation over the past century, however, has crystalized the meaning and effect of the law. In interpreting the Sherman Act, courts have attributed various purposes to the law, one of which is the promotion of a more competitive free-market economy.

This article identifies the various goals that are commonly ascribed to the Sherman Act, describes in detail the economic efficiency benefits that accrue from a more competitive economy, and explains how economic theory can be useful for detecting price fixing violations and how it may guide the formulation of effective remedies for convicted firms.

Rationale for Competition

Public Interest Theory of Regulation and Goals. The power of any state to act in behalf of the "natural persons residing in the state" presumes a public interest rationale for government intervention to remove market impediments to the competitive process. The meaning of "public interest" depends on the goals which motivate antitrust action. Economic efficiency, equity, business ethics, protection of small business, and decentralization of political power are various goals that have been attributed to United States antitrust enforcement efforts.

Economic efficiency is an important goal in promoting competition.[1] Fundamentally, economic efficiency means that firms produce at least expense those goods and services which consumers most desire and choose to purchase. This goal, which will be discussed subsequently in more detail, makes no judgment as to the distribution of income which permits (or restrains) consumers of various income classes to purchase those goods which they most desire.

Equity considerations are based on the view that the current distribution of income is not equitable. This is the underlying basis for the argument that the government should intervene in order to redistribute income toward a favored group. With antitrust, this could take the form of selective prosecution of industries whose supra competitively priced product is primarily purchased by the poor.[2] As a consequence of successful antitrust enforcement, the diminished price of a good effectively raises the real incomes of its purchasers.

Promoting business ethics or the moral conduct of business managers is a noneconomic goal which can complement economic efficiency but does not necessarily look at the competitive effect of this desired conduct. As an illustration, a large firm's lowering of prices in one geographic market may be viewed as morally reprehensible if smaller firms in the area are driven out of business. The effect is procompetitive in the long run if the price remains lower or closer to cost than previously, but is anticompetitive if the price eventually is elevated to the monopoly level.

Preservation of small business as a necessary part of our economic system may be a legitimate objective but is not necessarily an economic goal and thus may conflict with economic efficiency. If small businesses are the less efficient firms, promoting efficiency may drive them out of business. If small businesses comprise a pool of potential entrants, however, their preservation may enhance efficiency by limiting the autonomy of larger, established firms.

Decentralization of political power seems to be the goal underlying efforts to curb absolute firm size, which are often exerted under the antitrust banner.[3] The argument is that large firms have political clout that is disproportionate to their size. However plausible the argument, there is little systematic empirical evidence to support or reject it.

Private Interest Theory of Regulation. An alternative theory to explain government intervention is the capture theory, the regulation of industry stemming from industry demand for such supervision. This is less likely to occur in the case of antitrust because its wide scope of regulation is not confined to one type of industry as, for instance, is the Federal Communications Commission. Thus, there is less chance that any one industry will attempt to "capture" an antitrust agency which may

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never turn its attention toward the industry. The diversity of firms within industries also fails to support this theory for antitrust. Small businesses may have an incentive to invoke the attention of antitrust authorities in order to counteract the competition of lower-cost, larger firms in the industry, whereas these larger firms would discourage such action.

Efficiency: marginal cost pricing. Economic efficiency in a competitive market is based upon the theory of marginal cost pricing. Marginal cost represents the lowest cost to producers in terms of the sacrifice of resources necessary to produce one more unit of a product. Cost in this sense is actually an opportunity cost measuring the value of output which *could* be produced if the required resources were diverted to their next most productive use, i.e., the foregone production opportunity to society. If the price of a good reflects this opportunity cost, individuals are able to weigh the value they place on the good against the value that is placed on the alternative output potentially produced by the same resources. Should the alternative product be valued more highly, marginal cost pricing insures that the price of the good exceeds consumers' willingness to pay, and the alternative, more valuable product will be produced instead.

The theory of marginal cost pricing assumes that consumers maximize their satisfaction, purchasing items which yield them the greatest "benefit," and that producers maximize their profits, the difference between total revenue received from sales and total costs spent in producing goods or services.

To emphasize, when price is equated to marginal cost, price reveals the dollar value of employed resources if they were diverted to producing their next most attractive product. If price exceeds marginal cost, potential purchasers are being signalled that additional units of the good or service cost more than the true value of the next best alternative. Consequently, some consumers who value the product more than the value of the resources in their next best use refrain from purchasing the product. Production of the product, therefore, should be expanded. Conversely, when marginal cost exceeds price, production should be contracted. Only when price is set equal to marginal cost is it impossible to reallocate society's productive resources so that the gain in value resulting from increased consumption of the product whose output is raised exceeds the loss in value resulting from reduced consumption of the product whose output is lowered. In other words, marginal cost pricing leads to a maximization of the value to society of the goods produced (for a given distribution of income) by sending accurate signals of the value of alternatives to prospective consumers.

Marginal costs represent the lowest cost to producers in terms of the sacrifice of resources necessary to produce one more unit of a product.

Perfectly competitive markets. A perfectly competitive market ensures the price-marginal cost equality primarily because the number of firms is so great that the pricing behavior of any one firm cannot affect the market price. Each firm is forced to sell at the lowest possible production cost when it is facing the likelihood of losing customers to competitors who undercut its price. Thus, each firm earns no economic profits, those profits which are above the *normal* return on invested capital. Such behavior, however, characterizes competition only in markets where the products are homogeneous (contain identifiable characteristics which cannot be easily altered to differentiate the product within the market), there exists perfect information among customers and producers, and entry and exit are unrestricted. The possible entry of new sellers polices the behavior of established firms. Should price rise above cost, the resulting economic profits would lure new competition from potential entrants who would increase supply, thereby putting downward pressure on price until it once again equaled minimum cost.

Monopoly markets. A monopoly in the economic sense is the extreme case of a market having only one firm which no longer views price as given but expects sales to increase as price declines. Such evidence of a downward sloping demand curve (see Figure 1) implies that consumers purchase greater quantities of the product at lower prices. They do so for two reasons: (1) at lower prices consumers find the product more attractive relative to other items on which they might spend their budget, and (2) at lower prices consumers can purchase the identical selection of goods and have some portion of their budget left over, which might be spent on more of the product under consideration or on other goods.

In order to maximize profits, a monopoly firm sets marginal revenue equal to marginal cost, i.e., the additional revenue gained from selling another unit of output must cover the additional cost of producing it. The firm would not maximize profits if it failed to produce those units for which marginal revenue of the unit exceeded marginal cost. It would also reduce profits from the maximum level if it produced units of output which generated fewer additional revenue dollars than additional costs.

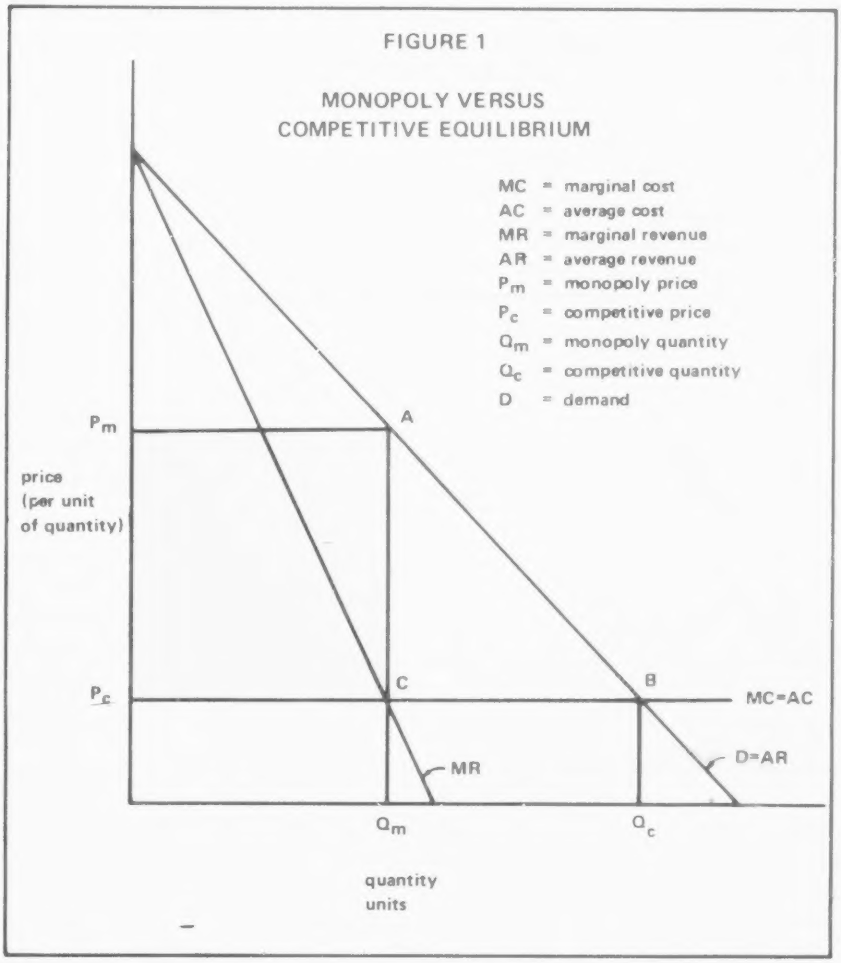
For the perfectly competitive firm, marginal revenue is equal to the price, so that marginal cost pricing is consistent with profit maximization (marginal revenue equal to marginal cost). In the case of the downward-sloping demand curve facing the monopolist, however, the marginal revenue curve lies everywhere below the demand (average revenue) curve (see Figure 1). This is because the extra (marginal) revenue from selling one more unit is the price (average revenue) of that unit *minus* the reduction in price (times the total number of units purchased) which is necessary to induce the sale of the expanded output and which also applies to those purchasers of the good at the formerly lower output and high price. (This analysis assumes that the monopolist cannot successfully price-discriminate; that is, the firm is assumed to charge the same price for all units of the product sold.) Therefore, a profit-maximizing monopolist setting marginal revenue equal to marginal cost necessarily causes marginal cost to be less than price. Consequently, consumers are misled as to the alternative value of resources used to produce the monopolized good.

By restricting output, the monopolist firm forces up the price. This may increase total revenues at first if consumers are not very responsive to price increases, because price would rise relatively faster than quantity fell. Since costs certainly decrease with reduction in output, a rise in total revenue would surely increase profits. As prices rise sufficiently, however, consumers will find substitute products attractive and become more responsive to price hikes. As consumers reduce purchases more rapidly than prices increase, the firm will incur reductions in total revenue. Because total costs continue to decrease with output restrictions, the monopolist may continue to inflate profits by restricting output even when total revenue declines. Eventually, however, the output restrictions will cause revenues to diminish more rapidly than costs are reduced. At this point the monopolist has attained the profit-maximizing output level. Profits are equal to the price less average cost times the output produced, which is represented in Figure 1 by the shaded area P_cP_mAC. Since there are no profits above normal returns in a competitive market, these monopoly profits in excess of competitive returns provide the incentive for firms to monopolize (or to form a cartel to behave as if several firms were a monopoly).

Efficiency loss. This distortion between price and marginal cost gives a faulty price signal to consumers by biasing upward the reported value of alternative (to the monopolized product) goods and services which could be produced with the currently employed resources. As a result, consumers fail to purchase certain output units which are valued in excess of their opportunity cost so that resources are diverted to substitute products and too few units of the monopolized product are produced. This loss of output is measured by the difference between the competitive output (Q_c) at the competitive price (P_c) equal to marginal cost and the monopolistic output (Q_m) at marginal revenue equal to marginal cost. The value to society of this loss in efficiency can be measured by the triangle ABC (see Figure 1), which represents the net damage as foregone consumer satisfaction due to the output restriction (the area under the demand curve – Q_mABQ_c), less the value of the released resources which are diverted to another activity (the area under the marginal cost curve – Q_mCBQ_c). There is a net loss even though resources are used to produce other goods and services, because consumers substitute products which are more costly to produce. If this were not true, the consumer would have preferred to purchase the alternative product *before* the price of the monopolized product was raised, in which case the price elevation would have had no effect on output decisions.

FIGURE 1

MONOPOLY VERSUS COMPETITIVE EQUILIBRIUM



. . . The theory of successful collusion hinges on sufficient barriers to entry to insulate a market from external competition and sufficiently few firms to stabilize an agreement to eliminate competition from within a market.

Collusion

A market with sufficiently few firms for each to recognize their interdependence lies somewhere between the extreme cases of monopoly and competitive markets. These firms have incentives to form a collusive cartel in order to emulate the monopoly structure. Acting as one, they may thereby gain market power to control price in order to reap monopoly profits.

The fewer the firms in an industry, the more closely its structure (the number and size distribution of firms) approximates monopoly and, therefore, the more likely it is to exhibit price-marginal cost distortions. Other, more intuitive reasons support this hypothesis. First, the fewer the number of firms in an industry, the simpler it will be for the firms to coordinate their actions and to agree upon common goals. This reduces the cost of collusion. Second, the fewer the number of firms in an industry, the larger is each firm's market share, in which case each participant in an agreement may earn potentially more monopoly profits from successful collusion. Finally, Stigler[4] has demonstrated rigorously that the incentives to cheat on one's cartel partners increase as the number of firms increases, in which case the stability of cartels diminishes with increasing numbers of firms.

Stigler shows that it is less difficult for firms to detect cartel partners' cheating if there are fewer firms in the cartel, because sales gains due to chiseling are more likely to come from a single rival firm, the fewer the other firms in the industry. The easier it is for other firms to detect chiseling, the lower is the chance of successfully gaining sales, thereby diminishing the incentive to cheat (and subsequently destroy the cartel) in the first place. Thus the fewer the firms, the more likely is the cartel to persist.

While fewness of firms is conducive to collusive pricing, a necessary prior condition is the existence of barriers to entry. A barrier to entry is a characteristic of an industry which allows existing firms in the long run to raise price above minimum average cost without inducing entry. Without barriers to entry, no reduction in competition among the established firms in an industry can successfully elevate price above cost in the long run, because the resulting profits will attract new competition from outside the industry.

Thus, the theory of successful collusion hinges on sufficient barriers to entry to insulate a market from external competition and sufficiently few firms to stabilize an agreement to eliminate competition from within a market. The theory employs the structure-conduct-performance paradigm. Characteristics of market structure (e.g., the conditions of entry, the number and size distribution of firms) create an environment in which firms can exercise various types of conduct or business strategies (price policy, product quality and variety, research and development and advertising strategies) which, in turn, lead to various levels of economic performance (the extent to which price accurately reflects social marginal costs of production, the technical efficiency within the firm, etc.).

The Policy Issue

The fundamental policy debate focuses on where in this chain of reasoning it is most efficient to attack the causes of poor industry performance. One view is that antitrust should focus on business conduct, ignoring market structure as long as it is benign. In some cases, fewness of firms is associated with the positive social benefits of lower costs at larger plant size (known as scale economies), which supports the contention that noncompetitive market structure may at times be beneficial.

An opposing view is that the regulation of the *use* of market power rather than the market power itself is too difficult and slow to be successful. Because many business practices which may harm competition and marginal cost pricing are similar in appearance to price competition, it is too difficult to regulate conduct. Thus, the argument goes, antitrust policy should focus on the structural conditions of markets, attempting to generate such conditions that business conduct, being naturally regulated by a competitive market structure (e.g., the presence of many firms or many potential entrants), cannot be detrimental. Proponents of this view usually argue that the advantages of scale economies have been vastly overestimated or that the social costs of misallocated resources are not worth the benefits of scale economies if the scale economies require firms to be so large that they have market power (i.e., they individually face a downsloping demand curve).

Empirical Evidence

There have been many efforts to assess the accuracy of the theory relating barriers to entry, numbers of firms, and firm size distribution to marginal cost pricing. Such research is known in economics as the "profits-concentration literature." The basic approach of such studies is to observe across industries, and within single industries over time, whether price-cost margins vary positively with market power, represented by the concentration of market share in a few firms.

Long-run profits above a normal rate of return are usually used to measure economic efficiency. If average costs are invariant with output level (i.e., there are no economies or diseconomies of scale, a reasonable characterization of cost conditions in the relevant output range of most U.S. industries populated by firms which operate more than one plant) then average costs equal marginal costs. Thus, excess profit per unit of output — the elevation of price over marginal cost — can be described by the price-average cost differential. *Short-run* economic profits are not used to measure inefficiency because they are consistent with the competitive market mechanism in which profits arise from increasing demand or decreasing costs and serve to induce entry, which exerts pressure on price to reduce profits to a normal return. Thus, temporary short-run price distortions contribute positively to the reallocation of resources to their most productive uses. Profit levels in excess of a normal rate of return (that rate earned by competitive firms which make zero monopoly profits) for a lengthy time period are a symptom that entry into the industry is impeded, thereby permitting a sufficiently small number of firms to raise price above marginal cost to gain monopoly profits, and chronically to distort price signals.

Firms which are more efficient may gain a larger share of markets, and because of their lower costs, will report higher profits.

The four-firm concentration ratio, which is the share of value of shipments accounted for by the largest four firms in an industry, is the measure commonly used to describe the number and size distribution of firms and implicitly is a proxy for barriers to entry. The main advantage of the four-firm concentration ratio is that it is published for all industries on a regular basis in the *Census of Manufactures*.

Most of the studies reveal a positive correlation between long-run profits and the four-firm concentration ratio. The more important issue for policy purposes, however, is the nature of this relationship, i.e., the levels of concentration where the correlation is strongest. Recent studies provide some guidance in determining significant ranges for two aspects of the relationship.

First, the effect of the leading four firms as a group on the likelihood for and stability of collusion may obscure the marginal impact of individual firms. John Kwoka[5] used data on the market shares of individual firms in 314 industries to examine the relationship of the first, second, third, and fourth firm's relative size on industry performance. He found evidence suggesting that market power is manifested mostly in the market shares of the leading two firms, with larger shares for the third or fourth firms acting to discipline the leaders' exploitation of their market power. This would be important, for example, in deciding the competitive impact of a proposed merger between two firms, currently ranked fifth and sixth in an industry, which together would generate a new and larger third firm and increase the four firm concentration ratio. The simple concentration-profits correlation suggests an anticompetitive effect of such a merger. Further research may serve to substantiate the implication of Kwoka's results, that such a merger could actually be procompetitive.

The second aspect of policy importance is whether the effect of concentration on price-marginal cost gaps varies with the level of concentration. A 5 percentage point increase in the share of the leading four firms may have no effect if it increases their share from 10 to 15 percent, because other competition prevents any pricing above cost. A similar 5 percentage point increase from 45 to 50 percent, however, might be just the amount of concentration required to enable the industry to successfully coordinate price increases. Finally, the 5 percentage point elevation of market shares from 90 to 95 may be unimportant if a 90 percent four-firm market share is already large enough to exploit fully any market power advantages available to the industry. Most studies of the critical level of market concentration have found the largest effect on economic efficiency (marginal cost pricing) when the four-firm concentration ratio is between 45 and 60 percentage points.[6] Kwoka found the critical size of *the* leading firm to be about 27 percentage points.

There are several alternative explanations for the positive relationship commonly found between concentration and long-run profitability. Firms which are more efficient may gain a larger share of markets and because of their lower costs, will report higher profits. Industries populated with such firms therefore tend to have higher concentration and higher profits as a result of this cost reduction efficiency.[7] Secondly, high profits may be due to short-run disequilibrium in certain markets.[8] Highly concentrated industries may be ones in which demand increases or costs decline markedly (one hypothesis being that firms with large market shares are more technologically progressive) so that what are labeled long-run are really short-run profits. These "persistent" short-run profits fulfill the valuable function of signaling changes in demand and costs and motivating a reallocation of productive resources to adapt to changing conditions. Third, if the world of business is characterized by purely random outcomes, then a statistical simulation of firm decision making results in the lucky firms receiving both higher profits and higher market shares.[9] Fourth, monopoly power and profits may both result from legally-sanctioned returns to scarcity, for example, to a patent. Finally, profits may be a legitimate return to risk. If the more concentrated industries are in riskier businesses, one would expect to observe a positive correlation between concentration and profits. The more sophisticated of the concentration-profits studies have attempted to deal with these alternative explanations for the positive relationship and generally have found that there remains some positive relationship that is unexplained by the alternatives, attributing it to the monopoly power hypothesis.

The Economic Theory of Detecting Price Fixing

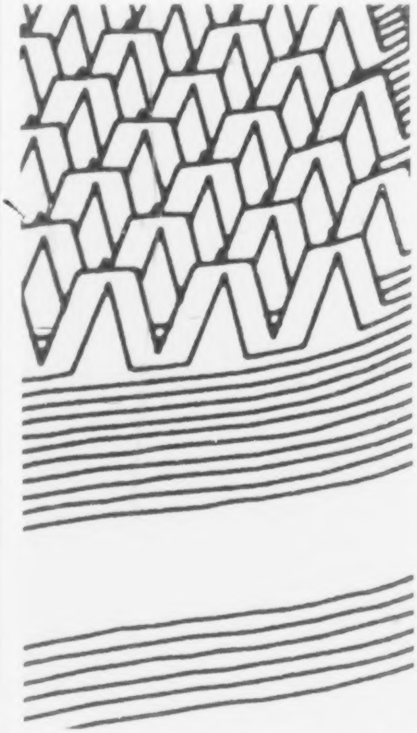
Theory and Empirical Evidence. The economic theory of collusion provides a useful tool for identifying prospective price fixing investigation targets. Since most economic theories are generalizations of behavior, with important exceptions, economics may be more appropriately applied in case detection than in eventual legal proof.

The impetus for collusion is the opportunity for firms in an industry to elevate profits above the competitive level by means of an agreement to fix prices. Inherent in the scheme is the temptation for any one firm to earn even higher profits by secretly lowering price enough to gain a higher market share, yet at approximately the monopoly price. Such behavior by numerous cartel members, however, would erode the elevated price (as output increased and a surplus materialized), and eventually undermine the agreement. If market conditions are not conducive to exposing cheaters, conspiracies may have to incur substantial costs to prevent the collapse of an agreement caused by individual firm "chiseling," in which case the attractiveness of the entire scheme is diminished.

Certain structural conditions of an industry influence the initial formation of a conspiracy, facilitate its coordination, and enable it to survive the internal cheating of its members and the external pressure of noncolluding entrants. Without ease of information exchange, an enforcement mechanism to maintain price among members and barriers to entry, the conspiracy will readily collapse without the necessity of antitrust enforcement action.

Stigler has developed the connection between a cartel cheater's likelihood of success and concentration in the industry. The ease of detecting secret price reductions depends on the probability of attracting new customers, which is proportional to the firm's share of industry output. With sufficiently few firms in an industry, each having a large market share, colluders are less likely to accept as random demand fluctuation a loss of share that occurs from a cheater's increased sales.

The relevant question for detecting price fixing cases thus becomes, how few is few enough for cartel success?



This is an empirical issue that hinges on group psychology: what number of firms is sufficiently small for reaching agreement? Moreover, the effect of fewness on price fixing cases is not likely to be uniform across market situations. While the general theory of collusion, based on the propensity of cartel members to cheat, predicts that fewness of numbers yields a greater likelihood of collusion, the coordinated action does not have to be of an overt nature. If the market is populated by sufficiently few firms that mutual understanding of the business strategy which best maximizes the joint interests of all firms in the industry can be accomplished without communication, explicit price fixing cases may be rare. In this situation the fewness of firms has led to an alteration in the form of monopolizing from direct price fixing to indirect monopolizing.

There is empirical evidence which supports this economic theory of collusion. Hay and Kelley,[10] using a sample of firms convicted of price fixing, found that the average number of firms in a conspiracy was 7.25, with 79 percent of the cartels involving ten or fewer members. The four-firm concentration ratio exceeded 50 in 38 out of 50 cases (vis-a-vis an all manufacturing average four-digit, four-firm concentration ratio of approximately 40). They concluded that concentrated markets, with relatively few firms, provide a lower cost of cartel planning and enforcement and less need for formal organizations which would raise the chance of discovery.

Fraas and Greer,[11] using the number of firms per industry as the basis of measurement, compared the frequency of industries (associated with different numbers of firms) for a sample of price fixing cases settled by *nolo contendere* pleas and consent decrees to the frequency of industries in a general random sample of industries. They found that the price fixing cases exhibited a greater frequency than the general sample in the four-to-nine-firm range and the 20-firm range, and that the high number of price fixing incidents associated with greater numbers of firms usually involved a trade association (to administer the agreement formally). Their findings are consistent with the general notion that explicit price fixing is less common when there are so many firms that coordination and policing of an agreement are impossible and when there are so few firms that an explicit agreement is unnecessary to achieve the goals of monopoly pricing.

Market Structure and Price Fixing. A price fixing conspiracy is more likely to be successful in certain structural environments. Two of the structural market characteristics are prerequisites for successful collusion: barriers to entry and homogeneity of product. Fewness of firms and homogeneity of product reduce the costs of collusion; and homogeneity, barriers to entry, and consumer insensitivity to price increase the prospective payoff from price fixing. The greater the return over costs, the more likely a conspiracy is to fix prices.

1. **Barriers to entry** protect the monopoly profits of the cartel from external competition. These may include patented production processes, trade secrets, product differentiation, economies of scale, large initial capital investments, legal entry barriers such as certificates of convenience and necessity, or an absence of reasonably priced distribution channels. If these barriers effectively impede entry, then the conspirators need incur no costs (in terms of sacrificed monopoly profits) to slow entry, for example, by lowering price sufficiently below the monopoly profit maximization level to discourage potential entrants. Thus, price fixing will be more profitable.

2. **Homogeneous products** encourage price competition, since non-price competition through product-variation is by definition impossible. The effect is primarily to decrease a cartel's policing costs by providing an unadulterated price which can be easily monitored for chiseling. In addition, advertising of a homogeneous product, which has no distinguishing characteristic, is relatively ineffective, meaning that monopoly profits will not be "competed" away by competition in advertising, again increasing profitability of a successful cartel.

3. **Consumer insensitivity to price**. The greater the insensitivity of consumer purchases to price, the more profits a cartel can make by price fixing. If demand is unresponsive to price, the restricted output of a cartel can not only reduce production costs, but may also increase total revenues, since price can be elevated without suffering much of a reduction in output. Declining costs and increasing total revenue will certainly create an incentive to restrict output. In addition, if consumers are relatively insensitive to price, potential entrants are likely to be pessimistic about the post-entry price they would cause by adding their output to supply. In order for the market to clear with the entrant's additional supply, price would have to fall dramatically. Consequently, a potential entrant would be deterred from entry and thus the cartel could more easily protect its monopoly returns.

Factors Stabilizing Collusion. Additional factors influencing the costs of a cartel include the absence of potential entrants, a high ratio of fixed to variable costs, a relatively static demand, the frequency of depressed economic conditions, and the dispersion of buyers.

1. **Absence of potential entrants or fringe of small sellers**. The existence of potential competition from a fringe of small sellers or potential entrants, waiting in the wings in industries with similar production processes or in other geographic markets, limits the behavior of established sellers. If the established firms elevate price too much, new entry will occur which subsequently increases supply and bids-down price.

2. **High ratio of fixed to variable costs**. The temptation to stabilize profits and to avoid the risk of price competition is especially high when fixed costs are relatively large, since losses caused by reduced market shares are severe if there is less output over which fixed costs can be allocated. Such industries are prone to price wars in order to expand market share, a fact which firms may recognize, prompting them to agreement.

3. **Relatively static demand**. A cartel's ability to detect cheating is enhanced when demand is stable. If conspirators can assume that only relatively small sales fluctuations are caused by sporadic shifts in industry demand, lost sales due to price chiseling can more easily be attributed to cheating, and the agreement is easier to police.

4. **Frequency of depressed conditions**. An industry which suffers bitterly during general economic downturns may turn to price fixing to maintain profits. Asch and Seneca[12] found that price collusion occurs more frequently in industries with low profits.

The greater the insensitivity of consumer purchases to price, the more profits a cartel can make by price fixing.

5. **Dispersion of buyers**. A large number of purchasers not only provides an opportunity for the cartel to allocate subsets of consumers among its members, but also reduces the incentives to cheat, which an infrequent nonrepeat single purchase creates. It is virtually impossible to advertise price cuts to a large number of disperse customers without revealing such cuts to other members of a conspiracy. In addition, many dispersed consumers are less likely to incur the cost of a private antitrust suit than would large buyers. Large purchasers also wield bargaining power through the threat of vertical integration to coerce favorable prices.

Price Information. Conspicuously absent from the considerations heretofore identified is any use of price information. The whole rationale underlying the advantages of a competitive market hinges on the relationship of prices to marginal costs. Although some price information can assist in case detection and selection, there are, however, numerous hazards with the standard ways in which these data are employed.

Although parallel prices, stable prices, price discrimination, and price increases in excess of the consumer price index are each consistent with price fixing, none in and of itself is conclusive proof of any illegal pricing action. Each of these four price patterns has alternative, perfectly legal, and plausible explanations.

. . . The major role of prices in a free market competitive economy is to signal changes in relative values and costs for different goods and services.

First, a price fixing cartel may elect to set identical prices for all goods and services, but a perfectly competitive industry will also evidence identical prices. Prices are forced to a similar level in perfect competition because the competitive pressure requires each surviving firm to operate at minimum possible costs and to price similarly.

Second, stable prices are sometimes thought to imply that cartelization has occurred. The rate of change in prices in any industry, however, is a function of the rate of change in underlying demand and cost conditions, and thus can be assessed only in comparison to those factors which would normally generate change. For example, prices may be very stable in a fiercely competitive industry if demand and cost conditions are stable. On the other hand, a successful cartel or monopolist will find it in its interest to change prices frequently in response to changing demand and supply conditions in order to continuously "fine-tune" its monopoly exploitation. Lastly, there are costs to changing prices, such as printing price lists, informing customers of new prices, and public relations hazards, which may affect the rate of price change in an industry, whether monopolized or not.

Third, different prices for similar products may resemble price discrimination, which requires market power to execute. Price differentials, however, are frequently a reflection of variation in the cost of servicing different customers; charging similar prices to customers whose servicing costs vary is itself discriminatory pricing.

Fourth, a comparison of price changes in one industry with the overall consumer price index incurs several risks. Prices may be rising more rapidly than the consumer price index because demand has shifted and the short-run reallocation mechanism of a competitive economy – high profits which induce entry – is at work. In addition, the major role of prices in a free market competitive economy is to signal changes in relative values and costs for different goods and services. If prices were not free to move in patterns at odds with the CPI, which is an average, there would be no need for the price system at all.

Price fixing will usually be accompanied by observable phenomena other than price patterns. For example, identical or rotating bids for government contracts, the exchange of price and output information, implicit price announcements in public forums, and stable market shares reflecting the division of the market are more obvious indicators which can be checked. At the formation of a price fixing cartel, it is necessary to reduce output in order to maintain an elevated price. Since capacity cannot usually be adjusted instantaneously, excess capacity will normally appear when the cartel is formed. On the other hand, there are alternative explanations for excess capacity (e.g., unexpected declining demand) so that this observation should be used cautiously.

Price Fixing Remedies

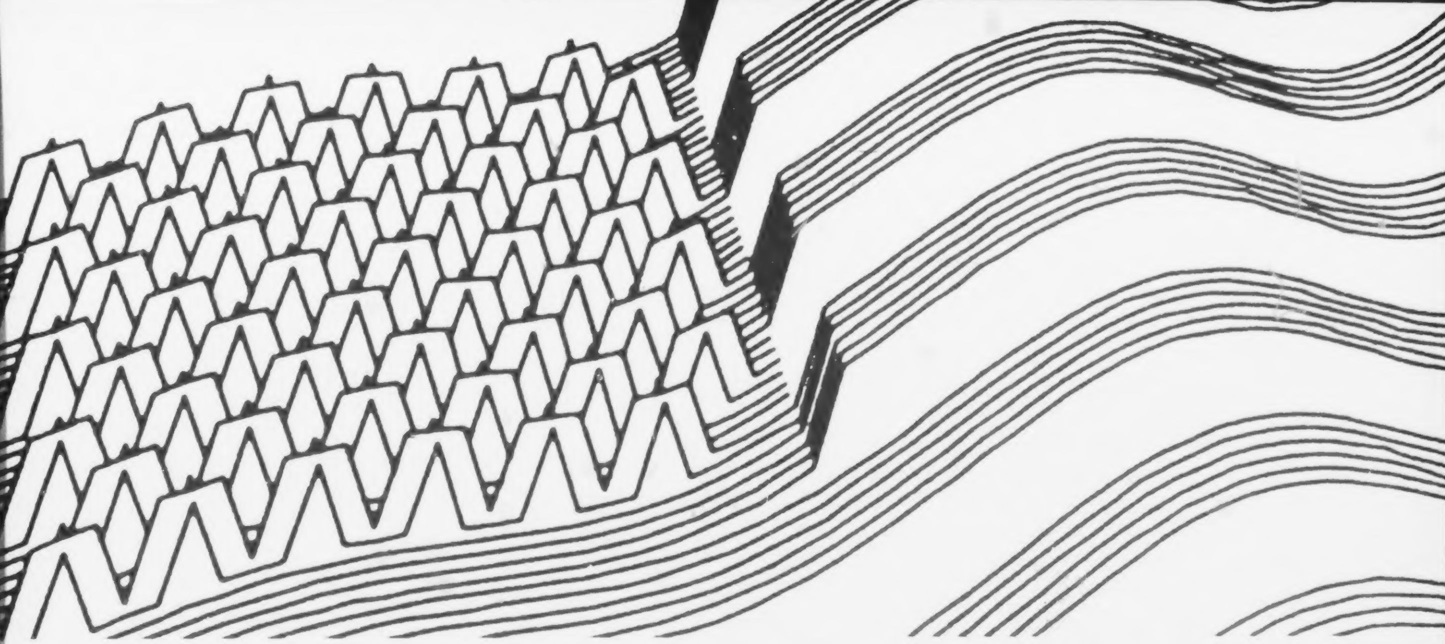
Another useful role for economics in antitrust enforcement is the formulation of civil remedies. If the major purpose of antitrust efforts is to improve competitive conditions (and deter other potential anti-competitive actions), then the effectiveness of the remedy is crucial for successful enforcement.

In price fixing cases there exists some explicit behavior that the court can identify as illegal, and which it can prohibit in the future by injunction. In most such cases, however, the behavior is usually widely recognized as illegal and is a *per se* offense. Thus, an injunction is already effectively issued against the behavior before it occurs. Since the conviction reveals that the injunction (*per se* rule against such behavior) was not sufficient to deter the violation, more severe penalties are in order. It is for this reason that criminal sanctions, both fines and/or incarceration, may be appropriate in criminal cases of *per se* violations.

In order to confront potential law violators with the expected cost of their acts, one must discount the cost of punishment by the probability of detection, apprehension, and conviction for the crime. Since each of these is usually less than unity, a penalty in excess of the actual social damages is required in order that potential violators are faced with an expected private cost of their action which reflects the social damages they would promulgate, a second reason for fines and incarceration.

In structural monopoly and other "rule of reason" cases, criminal sanctions may be inappropriate. If even a few individuals are punished severely for "crimes" that are subject to substantial discretion and judicial interpretation, aggressive competitive behavior might be deterred, resulting in a dampening of overall competitive zeal to the detriment of the economy.

In tacit collusion cases, it is difficult for the court to identify explicitly the action which is illegal. A judge can hardly tell firms in a tight oligopoly to refrain from recognizing their interdependence, an impossibility for profit-maximizing firms. Since the profit-maximizing oligopolist will inevitably take into account the effect of its strategies on rivals (and vice versa), the more appropriate remedy may be structural in nature. Industry reorgani-



zation, diminution of barriers to entry or improved access to capital and distribution of trade secrets may be more successful than injunctions to discontinue interdependent pricing, or fines and incarceration. The important issue in implementing structural remedies is whether there exists any prospect of permanently improving competition.

Economics provides the logical foundation for antitrust enforcement, the aim of which is to improve the economic welfare of society.

Conclusion

Economics provides the logical foundation for antitrust enforcement, the aim of which is to improve the economic welfare of society. The general theory of a competitive free market economy shows that monopoly will reduce overall welfare by providing distorted price signals to consumers, causing them to purchase the wrong combination of goods and services to maximize their welfare. Empirical evidence lends support to this general model of economic performance.

Economic theory predicts that oligopolies with too many firms for successful tacit collusion, yet sufficiently few firms to control cheating on a price agreement, are the best prospects for investigations. The existence of barriers to entry and a homogeneous product limits competition for the monopoly profits from potential entrants and from established firms, respectively; homogeneous products and fewness of firms reduce the costs of colluding. Investigations will stand a higher chance of uncovering violations if they are directed to industry situations where the benefits to price fixers are high and the costs are low.

An understanding of the economic foundations of antitrust policy is important not only for those who find in economics the exclusive rationale for existing antitrust legislation, but also for those who may embrace competing goals. Economics provides the latter group with a technique for evaluating the social costs of pursuing goals of antitrust policy other than efficiency. If the protection of a nonefficiency interest is espoused, then the costs associated with the choice should at least be identified and evaluated.

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Industrial Organization Economics At The Federal Trade Commission

William F. Long

(Editor's Note: From 1974 to 1979, David Qualls was an employee of the Federal Trade Commission in Washington, D.C. In his various roles as a staff economist, a supervisory economist, and a senior manager in the Commission's Bureau of Economics, he applied his understanding of the economics of industrial organization to a variety of issues in the area of antitrust policy. More recently, in collaborating with Joe S. Bain in the revision of Bain's classic text, **Industrial Organization**, *Qualls offered two reasons for research into the relations between industry structure and industry performance. The first is the desire for knowledge for its own sake. The second is the potential usefulness of such knowledge in the framing of antitrust or other public policies designed to improve economic performance. This article discusses how such research might be useful to the Commission as it attempts to improve the working of the competitive economy by its enforcement of antitrust laws. The views expressed in this article are the author's, and may not reflect the position of the Commission, individual Commissioners, or the Bureau of Economics.)*

The Federal Trade Commission is both a small group of five Commissioners and a small federal agency. Nominated by the President and confirmed by the Senate, a Commissioner serves a full term of seven years, though in some cases a person is nominated to fill out the remainder of a retiring Commissioner's unexpired term. By law, no more than three of the Commissioners may belong to any one political party. One of the Commissioners, at the discretion of the President, serves as the Chairman of the Commission.

The agency is responsible for the enforcement of a number of specific laws which fall into two broad groups – antitrust and consumer protection. An example of the former is the Clayton Act, while the Truth in Lending Act is an example of the latter. Two additional responsibilities of the Commission are also important: it is charged with the collection, study, and publication of information about the behavior and performance of business firms, and it is required to advise the President and the Congress on ways to improve business performance.

As noted above, the Commission is not very large. It has about 1,200 employees in Washington, and an additional 200 in 10 regional offices scattered around the country. The closest regional office to Tennessee is in Atlanta. The annual budget of the FTC in 1983 was $67 million, which ranks it near the bottom of even the independent regulatory agencies. Compared to an agency like the Department of Transportation (with a budget of $26 billion) or TVA (with a budget of $762 million) or even The University of Tennessee (with a budget of $384.8 million), the FTC is certainly not a large agency.

Commission Bureaus

About 650 of the Commission's employees are professionals, the vast majority being lawyers and economists, with a ratio of lawyers to economists of about three to one. The staff is divided into three operating Bureaus, Competition, Consumer Protection, and Economics, and a number of administrative support units.

It was only about a decade and a half ago that a separate Bureau of Economics was organized at the Commission. Before that, the organization had a Chief Economist but no separately recognized group of professional economists. The Bureau now has about 100 Ph.D.-level economists.

These Economists perform two fairly distinct functions. About half of them, or 46 percent, work directly with lawyers on cases or investigations in the antitrust area or the consumer protection area. The role of the economist in these areas is to provide independent analyses of the issues involved. The economists' contributions are intended to help the Commission select cases or projects which have a sound economic basis and to provide solid economic foundations for the lawyers to use in actually carrying out the casework.

The second function performed by economists at the FTC is economic research, which may focus on an individual industry or group of industries, a particular aspect of industrial behavior or performance or structure, or on some relation between industry variables. Some of the research is done because Congress or the President has specifically requested it, while other research topics are generated from within the Bureau of Economics.

As previously stated, the Commission has three operating Bureaus – Competition, Consumer Protection, and Economics. The Bureau of Economics is divided, in turn, into several sections, one of which is the Division of Industry Analysis.

Most of the work done in this Division is long-term in nature. Some of the studies involve the development of new concepts in industrial organization economics, though most of them rely heavily on models already developed by others, primarily academic economists. Virtually all of the studies also apply the models to real-world data, since that is necessary for the study to be directly relevant to policy making.

Frequently a fairly substantial data collection and refinement process is required before the economic concepts can be tested against the real world of commerce. Once the conceptual setting and appropriate data have been developed, a set of statistical procedures must be selected so as to produce results that take careful account of the special characteristics of the models and the data. Finally, of course, the whole project has to be written up into one or more reports and published in places where the results will be available for use by other people interested in the topic.

Qualls: A History

To illustrate this kind of work, I would like to focus on a set of studies P. David Qualls worked on while he was at the FTC. Qualls was a staff economist in the Division of Industry Analysis when he came to the Commission. He later became head of the division, with the title of Assistant Director for Industry Analysis, and went on to become Deputy Director of the Bureau, at which time he assumed administrative responsibilities for all the divisions in the Bureau.

> ***Frequently a fairly substantial data collection and refinement process is required before . . . economic concepts can be tested against the real world of commerce.***

Before he came to the Commission, Qualls had shown a substantial interest in the interaction of changes in the business cycle and the performance of firms in concentrated industries relative to those in unconcentrated industries. Soon after starting his FTC career in 1974, he embarked on a project to extend this interest, with the result that three articles in professional journals were eventually published.

The main issue in these three papers is the relationship between the extent of price variability and concentration across industries. Qualls was not primarily interested in the question of inflation, which has to do with the rate at which prices are increasing. He was concerned, rather, with the short-term variations of price from some "expected" level; the expected level could easily have some inflation factor built into it. He was, in addition, not primarily interested in what caused such short-term fluctuations in prices, but in their magnitudes in different industries. These concerns led him in 1974 to begin a substantial data collection and refinement process.

As with many economists in the industrial organization field, particularly those who had studied with Joe S. Bain at Berkeley, Qualls' "unit of observation" was usually the industry. He accepted the group of industries commonly referred to as the "four-digit SIC industries" as a useful starting place, though he knew in advance that he would have to make a number of adjustments to obtain data that satisfied his quality standard. The SIC (Standard Industrial Classification) system is supported by the federal government, and is used widely by both government statistical agencies and private business information services when it is necessary to classify activities of a business firm. It divides all economic activity into ten very broad categories, such as agriculture, mining, manufacturing, trade, and services. These categories are at the "one-digit" level, with some variations. Manufacturing is assigned the two digits 2 and 3. Further divisions are made, so that 28 refers to all chemical manufacturing, 282 is used for all plastics and other synthetic materials, and 2824 is used for noncellulosic organic fibers (nylon, dacron, acrilan, etc.) Thus, in this classification system, the greater the number of digits, the greater the level of disaggregation.

Once the decision about the unit of observation was made, Qualls faced a

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number of practical data problems. Since he could not collect data directly, he had to rely on data already collected by others. Instead of prices, he used the ratio of the excess of price over unit cost to price (called the "price-cost margin"), and for his source on those data he went to the **Census of Manufactures** and **Annual Survey of Manufactures** published by the Bureau of the Census. These two publications contain sums of data for plants which belong to each of the individual four-digit SIC industries in the manufacturing sector. The Census Bureau collects data (using its report form MA-100) from large plants every year, and from small plants every five years. Qualls tabulated these data for each year in the 1958-1970 period.

For data on industry concentration, Qualls went to another publication of the Bureau of the Census, **1967 Census of Manufactures, Concentration Ratios in Manufacturing**. These industry data show the percentage of total industry value of shipments which are made by the four largest companies in the industry.

Because the two major data items needed for the study were from the same source, Qualls could avoid some substantial data-matching problems. Even so, because he wanted industries reasonably descriptive of separate manufacturing activities, and for which data existed for the whole 13-year period, he finally settled on a set of 79 industries. This represents only 19 percent of the whole set of 422 manufacturing industries in the 1967 SIC system.

Compiling these data took Qualls the better part of a year, though he was involved in numerous other projects simultaneously. Once the information was in hand, he could put his understanding of the relation between price-cost margin variability and concentration together with the real-world data to see whether his model stood up to empirical testing. To do that third step required the selection of specific statistical procedures. Qualls went substantially beyond conventional approaches to empirical problems of this sort and selected some tests which were especially relevant to his testing situation.

Qualls finished the first version of the report in March, 1977, and circulated it to a small number of other economists for their critical comments by making it one of the "Working Papers" released by the Bureau of Economics. Qualls' paper, "Market Structure and Price-Cost Margin Flexibility in American Manufacturing, 1958-1970," was the first working paper in the series; in fact, one of his many contributions to the Federal Trade Commission during his five years there was his effort toward the establishment of the working paper series. It was certainly fitting that this paper would become Working Paper No. 1.

It was eventually published by **The Journal of Business** in April, 1979, with the title "Market Structure and the Cyclical Flexibility of Price-Cost Margins."

From the first serious notes, this project took Qualls at least five years, from start to finish. At the same time he had ~~an~~ increasing administrative load in the Bureau of Economics and also wrote two other major papers.

Of course, if we start counting from the time when the first data were collected by the Bureau of the Census, the project took 21 years, since the first year for which he gathered data was 1958. That seems to be a fairly lengthy gestation period, by almost anyone's standards. If we were looking at this project as a kind of "investment" in knowledge about how some part of the economy works, we might wonder how any project could be worth the effort if it takes so long. If that were not bad enough, it gets even more problematic when we note that this "investment" had not been used in any substantial way until 1979, so that the payoff, if there is one, did not start until then. What about the payoff, then?

Assessing Returns

Assessing the returns from the production and use of a research report is fraught with problems. What one would like to have are data on how the report was used and how much it contributed to society's wealth or satisfaction over and above what it would have been without it. We must settle for far less than that, unfortunately. The first clue we get is whether a report is cited by other researchers in the field. Quall's paper has been published for only a short time, so there has not been much opportunity yet for other researchers to cite it in their own research, but some evidence is beginning to show up. One of the most widely used textbooks in the field of industrial organization is F. M. Scherer's **Industrial Market Structure and Economic Performance**. In the second edition of the text, published in 1980, Scherer referred to Qualls' work in this and related papers. He noted that some of the findings disagreed with received theories in the concentration/pricing area; but he added that these findings would have to be tested further before their general validity could be determined.

Of course, it is the use by policy makers that we would like most to know about. On that score, we have little information, and getting it would be extremely difficult. We know, in general terms, that policy making depends in part on the whole body of research knowledge available, but sorting out which piece of information contributed how much to some specific policy is virtually impossible. Even if we could do it, five years is far too short a time for a research report to have had its full effect. Maybe political historians will be able to provide some insight on this point a few decades from now.

Though we cannot perform such a benefit "calculation" for specific research contributions such as Qualls' paper, we are convinced that in general such efforts are worth supporting. Careful and thoughtful research, such as that which Qualls conducted, contributes both to our overall understanding of the factors that influence industry performance and to the formulation of effective public policies which improve society's well-being. In addition, the example set by researchers like Qualls encourages us to increase our own efforts as well. ■

Theories of the Multiproduct Firm: Implication for Antitrust Policy

John W. Mayo

In recent years, since multiproduct diversified firms have become increasingly prevalent, more and more questions are being raised about the merits of such firms. Some economists and public policy officials have challenged multiproduct firms in certain industries, arguing that their presence could prove deleterious to prices, costs and the efficient flow of economic resources. In the case of the domestic energy industry this attitude has manifested itself in both the academic and legislative arenas. Professor Walter Adams has argued that "surrender of the substitute fuels industry to the petroleum giants will only solidify existing patterns of cartelization and retard rather than stimulate interfuel competition."[1]

Typical of legislative efforts to divest multiproduct energy firms is the Oil Windfall Acquisitions Act of 1979. This act, if passed, would have amended the Clayton Act to prohibit any major producer of crude oil from acquiring control through merger, consolidation or acquisition of (1) any other corporation in the business of energy exploration, extraction, production or conversion, if that corporation has total assets of $100 million or more, or (2) any corporation not in such energy businesses, if that corporation has total assets of $50 million or more.

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Another industry whose multiproduct tendencies have recently come under question has been the financial services industry. Restrictions on product expansion by financial institutions are contained in the Glass-Steagall Act, while the Bank Company Holding Act also places limits on the activities in which banking organizations can engage. The Glass-Steagall Act generally mandates the separation of commercial and investment banking. Various provisions of the Act prohibit national and state banks that are members of the Federal Reserve System from dealing in stocks or other securities and from issuing, underwriting, selling or distributing stocks or other securities. Also, firms that deal with securities are prohibited from engaging in the business of receiving deposits. Section 4(a) of the Bank Company Holding Act is a general prohibition on non-banking activities, while Section 4(c)(8) permits bank holding companies to engage in activities that the Federal Reserve Board has determined, "to be closely related to banking or managing or controlling banks. . . ."

It is clear that the cost of producing both mutton and wool jointly on a single lamb is less than the cost of producing them separately.

In contrast to those who challenge multiproduct firm structure, some economists appear to dismiss concerns about multiproduct, diversified firms out of hand, arguing that diversification or multiproduct operations *per se* does not affect market structure and, as such, should not be a source of concern. This view has been taken by many, including Markham, who argues, "We are led to the conclusion that highly diversified firms present no special antitrust problems, and require no special antitrust policy."[2]

In this article I will argue that both these views – the "market power expansion" view and the "laissez faire" view – are somewhat myopic and tend to be based on ideological preconceptions rather than the result of systematic economic analysis within a sound methodological framework. After briefly reviewing the existing literature, the article will posit a general paradigm within which analysis of multiproduct firms might be conducted, and which can serve as the foundation of a rational public policy toward multiproduct firms.

Theories of the Multiproduct Firm

To a large degree, the lack of an established policy toward, and understanding of, multiproduct firms can be attributed to the numerous ways in which the existence and behavior of these firms have been explained. The literature has been quite diverse in nature, sometimes contradictory, and subsequently has often forced the policy analyst into an approach that is based on ideology rather than objective economic analysis. However, despite the magnitude of the literature and diversity of opinions, a relatively simple taxonomy is offered here. Four broad theories of the existence and behavior of multiproduct firms and their subsequent policy implications are identified and discussed.

Technical Economies. Perhaps the earliest recognition of technical cost savings from multiproduct operations was made by Alfred Marshall in his work on joint production.[3] Examples of joint product goods make clear the advantage of multiproduct organization. For instance, it is clear that the cost of producing both mutton and wool jointly on a single lamb is less than the cost of producing these separately. While not all examples of cost savings through multiproduct organization are as clear as the joint product case, the potential for technical economies as a motive for multiproduct operations has increasingly been recognized. Recent theoretical developments have served to develop relatively simple, measurable cost concepts that are capable of depicting the degree to which savings from multiproduct organization result. A central feature of this research is the concept of economies of scope. Economies of scope for the production of two (or more) goods is said to exist whenever the cost of producing the goods jointly in a single firm is less than the cost of producing the same set of goods, each by a different firm. Diseconomies of scope occur whenever the cost of joint production exceeds the cost of producing the multiple outputs with separate firms.

The similarity of the multiproduct concept of economies of scope with the more widely recognized single product concept of economies of scale should be readily apparent. For single product firms, the shape of the firms' cost function – including whether there are economies or diseconomies of scale – dictates the number of firms that comprise the cost minimizing industrial structure. Similarly, the concept and measurement of the degree of economies of scope prescribe the cost-minimizing breadth of firms' activities. Furthermore, at the most basic level, economies of scale arise from indivisibilities of inputs and the increased efficiency that comes from specialization of tasks. In the same way, economies of scope arise from the ability of firms producing two or more products to pool certain inputs and to use these inputs more efficiently than they could be used if production were performed disjointly.

Recently the concept of economies of scope has been expanded by Teece to a world of positive contracting costs and other market frictions.[4] Teece argues that in a world of zero transactions costs, the presence of economies of scope gives rise to multiproduct organization of production, but not necessarily multiproduct firms. This is because economies of scope between products A and B that arise from indivisible common factor inputs could be internalized through leasing access to the excess capacity rather than through firm diversification. However, recognition of the difficulty of internalizing excess capital capacity, managerial talent, or research and development spillovers through the contracting process provides a rationale for firms to diversify.

The importance of determining the presence or absence of economies of scope for the appropriate public policy toward multiproduct firms is obvious. If the cost structure of producing multiple outputs is characterized by economies of scope, then multiproduct organization can be supported on efficiency grounds, ceteris paribus. This multiproduct organization may take either the form of multiproduct firms or, depending on the extent of contracting costs and other market frictions, a set of single product firms that contract among themselves to avail themselves of the economies of scope (e.g., joint ventures). This suggests that, in the absence of other motives for multiproduct operations, divestiture of multiproduct firms whose cost structure is characterized by economies of scope would have deleterious effects on firm and industry costs. However, even if such economies exist, there may be mitigating factors, such as market power, which would temper an anti-divestiture posture.

Market Power. Although market structure impacts of firm diversification are minimal, several potentially objectionable and anticompetitive effects may result from multiproduct operations. These include the acquisition or extension of market power, cross-subsidization, the erection of barriers to entry, reciprocal dealing, spheres of influence agreements, and the retardation of innovation. These topics will be addressed in turn.

The primary charge with respect to multiproduct firms regarding the acquisition of new market power or expansion of current market power has been that unchecked expansion by multiproduct firms constitutes an undesirable aggregation of economic clout. This argument appears to stem from the philosophy that firm size, as distinct from market dominance, can be an undesirable phenomenon. Michael Pertschuk, former chairman of the Federal Trade Commission, in testimony on conglomerate firms before the Senate Judiciary Committee, seemed to espouse this view when he stated, ". . . Our central concern is with the bedrock political principle enunciated by Jefferson. As a nation we do not now, and never have trusted excessive concentrations of social, political or economic power."[5] This notion that multiproduct firms may have excessive clout often manifests itself in the fear that multiproduct firms may unduly affect public policy in their favor. Pertschuk has argued, "It (the diversified firm) can gain a further advantage if it can spread the fixed costs of its lawyer-lobbyist and Washington specialists over its wider political activities."[6]

> ***Presumably the effect of cross-subsidization through predatory pricing is to drive out competitors so that future monopoly rents in the presently subsidized product line might be earned.***

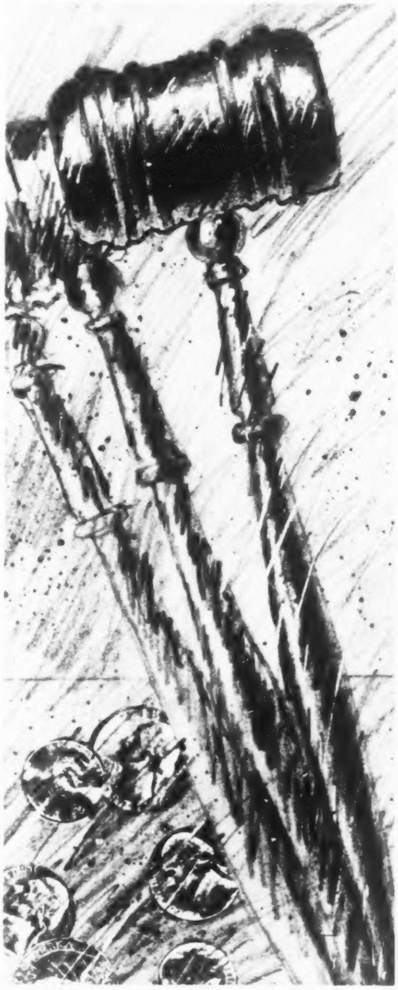
However, the validity of these concerns is subject to debate. First, product diversification and the subsequent pooling of lobbying efforts would appear to be relatively expensive when compared to alternative means of coordinating attempts to influence legislation, taxation and regulation. Political action committees and industry associations are quite capable of taking advantage of any economies of scale in lobbying efforts and do not burden firms with increased managerial responsibilities that accompany product diversification. Furthermore, even if multiproduct operations are chosen explicitly to take advantage of a communality of interests and economies in lobbying efforts, it is not clear that this is an undesirable phenomenon. As was pointed out in the last section, combining inputs common to the production of multiple outputs can provide a source of economies of scope and increased efficiency. Conceivably then, both efficiency and market power effects may arise from multiproduct activities, which complicates policy decisions.

A second potential ill effect of multiproduct firms is their ability to engage in cross-subsidization through predatory pricing. While there is some disagreement about the semantics of what is meant by cross-subsidization, the general idea is that a multiproduct firm will use the divisional profits from one product line to subsidize abnormally low or negative cash flow in another product line, which results from pricing below average variable costs. John Blair has argued that "Cross-subsidization is destructive of competition since it makes the plight of the single-line producer all but impossible. Even though in his own industry the single-line producer is more efficient than the conglomerate, there is little point in pursuing the course of action held out by classical theory – i.e., reducing his price to reflect his greater efficiency – since his price reduction would only be matched or exceeded by a firm that can easily afford to accept losses in his industry."[7]

Presumably the effect of cross-subsidization through predatory pricing is to drive out competitors so that future monopoly rents in the presently subsidized product line might be earned. Note, however, that both the ability and wisdom of multiproduct firms to engage in cross-subsidization have been challenged and debated vigorously. Furthermore, if cross-subsidization is used to circumvent financial barriers to entry or to stabilize earnings, then it is not clear that there are negative implications of this practice.

Often the emphasis of industry studies is on the existence or likelihood of anticompetitive practices among established firms. However, an important determinant of firm performance and future industry structure is the ease of entry into the market by new firms. Over 25 years ago, Bain identified three primary types of barriers to entry that can lead to prices above the competitive level for established firms: economies of scale, absolute cost advantages and product differentiation.[8]

To the extent that these factors serve to deter entry in single product industries, barriers to entry may be heightened in an industry characterized by multiproduct firms. For instance, consider the impact of multiproduct economies on the ease of entry. If multiproduct operations are characterized by no economies of scale, no interproduct complementarities in production, no financial economies, and no economies of joint distribution and marketing, then multiproduct firm structure is neutral with respect to entry barriers. If, however, there are economies of scope for established multiproduct firms, then the cost of joint production is less than the cost ~~of~~ production for single product firms. This means that the potential entrant considering production of a single product will face a cost disadvantage. Alternatively, the potential entrant could circumvent this cost disadvantage by entering simultaneously in all the product lines over which the economies of scope extend. However, the ease of entering as a multiproduct firm will depend on the extent of economies of scale in each individual product produced and the extent of financial barriers to capital markets. Economies of scale in the individual product lines suggest that cost efficient entry be at a large scale. In a market with both economies of scale and economies of scope, the potential entrant must not only enter at a large scale to compete, but it must do so in more than one product line. The potential entrant in this situation is likely to face very large capital requirements. To the extent that these capital requirements represent sunk costs or can be met only by paying higher per-unit capital costs than established firms, entry as a multiproduct firm is discouraged.



Other potential market power impacts of multiproduct firms' structure are the potential for reciprocal dealing and spheres of influence agreements. Reciprocal dealing between two multiproduct firms involves the agreement by firm A to purchase some inputs from, or sell some of its outputs to firm B in one market in exchange for a reciprocal arrangement between the two firms in another market. Spheres of influence agreements among multiproduct firms that compete in several markets involve an arrangement that aggressive price and advertising policies will not be sought by firm A in one market in exchange for an agreement by firm B to avoid these strenuously competitive practices in other markets where the firms compete. To the extent that reciprocal dealing and spheres of influence agreements are carried out by multiproduct firms, economic resources are misallocated and prices are driven to above competitive levels. Several cases of reciprocal dealing and spheres of influence agreements have been alluded to in the literature; however, the ability of multiproduct firms to engage in agreements of this nature for extended periods of time is limited by the same factors that limit explicit cartelization in single product industries. These factors include a profit maximizing incentive which encourages individual firms to cheat on the agreements and makes it difficult to monitor any accord that is reached.

Financial Economies. In addition to technical economies and market power motives for firm diversification, a literature has developed which suggests that multiproduct firm structure is motivated by a desire to capture financial economies. These financial economies arise either because of reduced average cost of debt and equity issues, or due to decreased riskiness of the multiproduct firm. We focus here on the possibility that multiproduct firm structure reduces firm risk.

The history of the literature on risk reduction as a motive for multiproduct firm structure has been quite tortuous. Early work on the role of conglomeration in reducing risk emphasized that unless the profits of operating in market j and in market i were perfectly correlated, the overall variance of firm profits as a percent of mean profits could be reduced by extending firm operations into both markets. The problem with using this notion as the foundation for a theory of the multi-

In addition to technical economies and market power motives for firm diversification, a literature has developed which suggests that multiproduct firm structure is motivated by a desire to capture financial economies.

product firm, however, is that it ignores the theory of asset pricing known as the Capital Asset Pricing Model (CAPM), which was developed in the mid-1960's and is now widely adopted by both financial theorists and practitioners. The CAPM is a zero transactions and information cost model that is devoid of taxes, regulations and market interfering mechanisms. As a result, investors can alter their asset portfolios without cost and hence will arrange their portfolios to eliminate all the risk that firms could otherwise achieve through diversification. This would appear to eliminate the motive for multiproduct firm structure for the purpose of risk reduction.

However, upon deeper inspection of the CAPM, there appear to be several ways in which diversification may result in financial economies. Consider the modification to the CAPM that allows for transactions and information costs to be non-zero. As a result of brokerage fees, odd lot premiums, and other market transactions costs, not all investors hold the optimum (market) portfolio. In this event, it has been shown that it is possible for diversification to benefit shareholders, and hence provide a rationale for multiproduct firm structure. In a similar vein, it has been suggested that given information costs, asymmetric information between managers and shareholders can stimulate multiproduct firm organization. In particular, it is argued that managers may have greater knowledge than shareholders of diversification opportunities that would lead to the realization of economies of scope. However, that there are information asymmetries is too strong a requirement for this motive for firm diversification. Even if shareholders and managers were equally informed regarding opportunities for technical economies, shareholder portfolio diversification cannot capture these economies. As such, information asymmetries between shareholders and managers constitute a sufficient, but not necessary, rationale for multiproduct firm organization.

In the absence of market imperfections, unless diversification somehow alters the firm's cash flows, there appear to be no purely financial economies from multiproduct organization. However, Greenberg, Marshall, and Yawitz have shown, within the context of CAPM, that firm diversification can fundamentally reshape the nature of cash flows accruing to the firm.[9] Intuitively this occurs because when firms operating in one product line alter their output, a financial externality on firms operating in another product line is created. Joint production via multiproduct firm structure enables firms to internalize this externality, and achieve risk reduction by operating in markets that have negative covariances of their cash flows. However, while the potential for financial economies of the Greenberg, Marshall, Yawitz type always exists, the ability of a firm to avail itself of reduced riskiness through diversification will be limited by the extent of its market share. This, in turn, points to the problem of identifying the individual impacts of multiproduct firm structure and market power as factors in reducing firm risk.

Several unanswered questions regarding financial economies leave the appropriate public policy toward them somewhat unclear. Principal among these are: (1) Do financial economies represent a true efficiency gain, or are they, in some sense, illusory? (2) To the extent that financial economies motivate multiproduct firm structure, are they passed on to consumers, or are they taken in the form of higher price cost margins? (3) To what extent might the presence of reduced risk for multiproduct firms be the result of market power rather than financial economies?

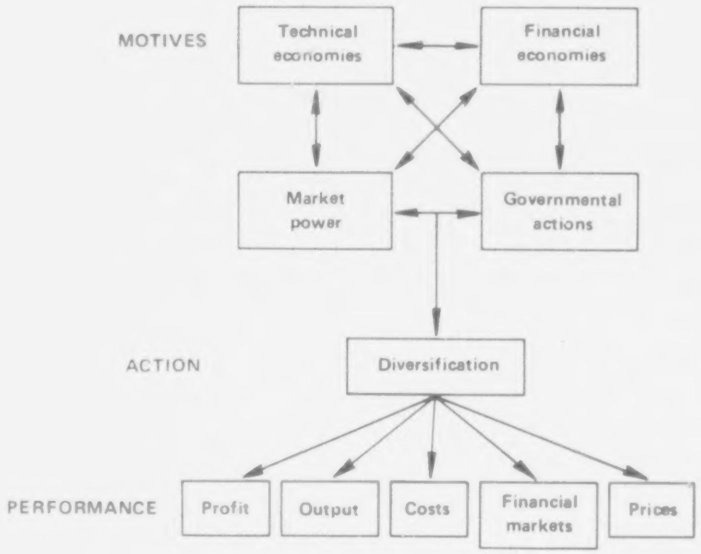
Government Taxes, Regulation and Antitrust Policy. The idea that firm structure and output mix might be altered by governmental action is not new. To the extent that governmental taxes, subsidies, regulations and price controls set the environment in which firms operate, it would indeed be surprising if changes in these factors left firm output unaffected. Nevertheless, there is not an explicit literature on how governmental actions might, at least in part, be responsible for the growing number of multiproduct firms. Two possible areas of governmental action are identified here that may affect the incentives for firms to diversify. First, consider the impact of tax policy on firm structure. Barzel has shown that the imposition of per-unit taxes on cigarettes changed the output mix of cigarette manufacturers.[10] In particular, the imposition of per-unit taxes resulted in firms producing longer cigarettes. In some cases, vertical integration can be used to avoid or reduce various types of taxation. The clearest example of this is vertical integration to avoid a turnover tax, which is imposed on sales at each vertical level of production that is "exposed" to the market. In the case of energy tax policy, a 1980 proposed California law would have imposed a surtax on any firm that received more than 50 percent of its net income from petroleum operations. The obvious ramification of such an act, if passed, would be for California-based petroleum firms to diversify into non-energy activities in order to avoid the incremental tax burden.

Also, it is quite possible that government regulation and antitrust policy may promote multiproduct structure. Scherer has argued that, "One probable effect of the gradual turning of the antitrust screw was a redirection of businessmen's urge to merge. . . . The proportion of assets changing hands through horizontal mergers declined sharply as antitrust enforcement became tougher, while conglomerate mergers advanced in relative importance."[11] Similarly, government regulation of one product may catalyze diversification by firms into related, unregulated products.

A Framework for Analyzing Multiproduct Firms

Because the literature on the multiproduct firm is seemingly so diverse, it is useful to synthesize the relevant concepts into a general framework. This is not to suggest that a single theory of the multiproduct firm will, or should, emerge, but rather to provide the antitrust analyst with a consistent framework within which to operate. The Motives-Action-Performance (MAP) paradigm depicted schematically in Figure 1 suggests that multiproduct firm performance will depend on the nature and direction of the diversifying action. The action of becoming a multiproduct firm is, in turn, seen as the result of one (or more) of four potentially motivating forces. While in this simple framework the direction of causality is assumed to flow from motives to action to performance, a more sophisticated analysis should recognize the potential for feedbacks from performance to motives.

FIGURE 1
A SIMPLE FRAMEWORK FOR ANALYZING MULTIPRODUCT FIRMS



The four potential motives identified are taken from the extant literature: technical economies, market power acquisition and extension, financial economies and governmentally induced diversification. Two issues are particularly important at the Motives stage of the MAP paradigm. First, identification of the motive(s) for a particular firm's diversification is particularly important because traditional reliance on market structure to identify subsequent performance is confounded for multiproduct firms. For example, Bradburd has shown within a CAPM framework that the price and output of multiproduct firms will in all likelihood differ from that of their single-product counterparts, despite total similarity of market structure.[12] Furthermore, identification of the true motive(s) for diversification is important because different motives imply different public policy responses. If technical economies have motivated multiproduct firm structure with no market power influences, then an antitrust divestiture policy would clearly be inappropriate. On the other hand, if there are no technical or financial economies, but there are some market power motives for firm diversification, then antitrust remedies should be sought.

Clearly, the most difficult public policy decisions occur when elements of market power *and* technical or financial economies have motivated a firm to produce multiple outputs. This then, is the second important point regarding motives for multiproduct diversification: there may be significant interrelationships between the motives that make public policy inferences quite difficult. Conceptually, the correct approach toward understanding the merits of multiproduct firms, when elements of market power and economies are present, is to compare the market power welfare loss associated with diversification and the welfare gain associated with the technical or financial economies.

The Action level of the MAP paradigm suggests that several pieces of useful information for public policy purposes can be gleaned from analysis of the actions by which firms become multiproduct. For example, it is useful to know whether multiproduct expansion was through merger or de novo entry; whether the firm diversified into related or unrelated products; and whether R&D, advertising and investment intensity patterns were altered by multiproduct structure.

Finally, several indicators of multiproduct firm performance provide evidence on the merits of firm diversification. Principle among these are profits, outputs, costs, prices and financial market data. These data can be useful in attempts to identify the underlying motive for a particular firm or industry's trend toward multiproduct operations. As was noted earlier, however, a single given performance indicator for multiproduct firms may be a poor indicator of the underlying motive for diversification. For example, high post-diversification profits may be the result of virtually any of the four identified motives. For this reason it is particularly important to examine several dimensions of multiproduct firm performance before making an inference regarding which motive(s) stimulated firm diversification.

Summary and Conclusion

The number of multiproduct firms has increased sharply to the point that they are far more often the rule than the exception in the United States economy. In the wake of this growth, the literature on multiproduct firms has also grown sharply. However, until now, the literature has been disjointed, sometimes contradictory, and has suffered from more than its share of semantic problems. In offering a general framework within which the merits of multiproduct firm structure might be identified, many more questions were raised than answered. However, the hope is that with this framework in hand, those dealing with the question of antitrust policy toward multiproduct firms might have a common conceptual approach that enables them, at least, to agree about which points they disagree.

Clearly, the most difficult public policy decisions occur when elements of market power and technical or financial economies have motivated a firm to produce multiple outputs.

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